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RUBBER RESEARCH.

Every new industry presents us with new problems for solution, and the plantation rubber industry has not been an exception to the rule. Indeed, when compared with other plantation products, it may be said to have far surpassed them, from the planter's point of view, in the number and diversity of its problems. Questions of methods of cultivation, tapping, etc., were provisionally settled on a working basis comparatively early, though it would be idle to claim that we have reached finality in any branch. But in addition to these there was the problem of manufacture, and, though in cultivation and tapping the planter could satisfy himself that he was on right lines, early experiments in manufacture produced such inexplicably contradictory results that no sure foundation was possible.

When plantation rubber began to be put on the market in large quantities, and the manufacturers demanded a fixed standard of quality, the need of detailed research on coagulation and manufacture at once became evident. The old type of experiment, in which many undetermined factors influenced the result, was seen to be inadequate, and it was recognised that the precise influence of every factor must be determined separately, if any advance was to be made.

To meet this situation, as far as Ceylon was concerned, the Ceylon Rubber Research Scheme was instituted, the necessary funds being raised, partly by the Ceylon Government and partly by subscriptions from estates. A detailed scheme of investigation was drawn up by PROFESSOR WYNDHAM R. DUNSTAN,

Director of the Imperial Institute, in consultation with Ceylon planters and experts, and this has been systematically pursued during the last three years. Vulcanising plant has been erected at the Imperial Institute, where the vulcanisation and testing of the samples, coagulated on the lines laid down, is carried out by a trade expert. The rubber is thus vulcanised and tested at an age comparable with that at which it reaches the manufacturer.

As so many different factors have to be considered, progress in rubber research is necessarily slow at first. In this, as in all other research, short cuts lead nowhere, and are in the end only a waste of time. But a reference to the circular which we reproduce in this issue will show that the preliminary stages have been passed and important conclusions are now being reached. In addition, the investigations conducted by MR. L. E. CAMPBELL, the Rubber Research Chemist, into the physiology and structure of Hevea, the influence of tapping on food reserves, etc., have produced a volume of information which is of the highest importance in estimating the probable value and effect of tapping systems.

A perusal of the circular will reveal to those who are not already subscribers the valuable character of the work which is being done, and can hardly fail to induce their support.

T. PETCH.

CEYLON ORANGES.

MR. G C. BLISS has kindly favoured the Department of Agriculture with two magnificent specimens of the Seville orange, grown at Glenlyon, Agrapatanas, one of which weighs just under 17 ounces and the other slightly over 13 ounces. Their girths are 14 and 13 inches, respectively.

We may add that, a few years ago, when two officers of the United States Department of Agriculture visited Ceylon in the course of an exploration through the East in search of fruits, etc. for introduction into America, the plant which impressed them most in Ceylon was the Seville orange tree in the Hakgala Gardens, though its fruits are small in comparison with those referred to above. T. P.

RUBBER.

CEYLON RUBBER RESEARCH.

The work undertaken by the Group of Subscribers, the Department of Agriculture, and the Imperial Institute, to investigate the problems connected with the coagulation and preparation of rubber and the effects of tapping on trees, has been in progress three years, with an interval in Ceylon of six months. It may be advisable briefly to state the results that have so far been reached.

PLAN OF INVESTIGATIONS.

It was necessary to decide upon a definite scheme of work, and to obtain the services of a well-trained chemist for preparing rubber samples, so that uniformity in them might be secured. The samples were sent to the Imperial Institute, where the Ceylon Government had erected a Vulcanizing Installation. It was deemed advisable for the vulcanization to be done in London, where close touch could be kept with manufacturers. The vulcanization and tests were conducted by the staff of specially trained men at the Institute. The work in Ceylon was carried out by MR. L. E. CAMPBELL.

The scheme of work, it will be observed, is confined to research, and does not at present permit of visits to factories to advise Superintendents on methods of rubber preparation. Subscribers are kept fully informed of the progress of our work by means of Bulletins, fourteen of which have so far been issued. For investigating such problems as we are concerned with, we must have—

(1) Scientific preparation of samples in Ceylon.
(2) A definite plan to work to.
(3) Vulcanization under conditions corresponding as nearly as possible to those of manufactories. Vulcanization in Ceylon would not therefore be satisfactory.
(4) Tests conducted by an independent and responsible body.

A representative of Dunlop's, one of the firms with which the Imperial Institute is in touch, who visited Peradeniya a few months ago, said that he considered this work more important than any other being carried out in the East in connection with the rubber industry.

RESULTS HITHERTO OBTAINED.

The work of investigation is not yet concluded, but some important results have been obtained. The most noteworthy are as follows (references are to the vulcanized products):—

(1) Acetic acid is on the whole the best coagulant that can be used at present.
(2) Latex allowed to coagulate naturally, without the addition of any coagulant, yields rubber of good quality.
(3) Rubber allowed to remain wet after coagulation (creosote having been added as a preservative) is quick curing and strong.
(4) Washing dry rubber on its arrival in London does not affect the quality.

(5) The addition of creosote does not affect the quality.
(6) Crêpe takes longer to cure (vulcanize) than plain sheet.
(7) Smoked sheet takes longer to cure than plain sheet: thus smoking retards curing.
(8) Plain sheet is often stronger than crêpe, and, in some cases, than smoked sheet.
(9) Smoking would appear in certain cases to affect adversely the strength of the rubber (smoked sheet), but final conclusions as to this cannot be drawn till samples now under examination have been tested.
(10) Repeatedly passing crêpe through rollers does not injure it.
(11) There is little or no difference between thin crêpe and thick crêpe prepared from dry thin crêpe.
(12) It is a matter of indifference, as far as quality goes, whether crêpe is air-dried, or dried in hot air or in vacuo.
(13) Making dry rubber into block or roll does not appreciably affect the quality or rate of cure.

TIME OF CURE (Vulcanization).

This is of great importance to a manufacturer, because the best results are only obtained when the cure is perfect. Rubber that is over or under cured will result in inferior quality goods. Large manufacturers make their own preliminary tests to guide them, but small manufacturers are often unable to do this owing to lack of a scientific staff and special plant.

Our samples are, as has been stated, vulcanized at the Imperial Institute. So far, the time required for vulcanizing them has varied from 38 to 140 minutes. This reveals with regard to plantation rubbers a very great factor of uncertainty, which we may, as a result of these investigations, be able to some extent control.

STRENGTH OF RUBBER.

The diversity in prevailing systems of preparation does not affect the strength of the vulcanized product to the same extent as it does the time of vulcanization. Of 207 specimens, 120 withstood a strain of 2,300 lb. per square inch, and 62 of 2,400 lb. and over. The breaking strains of two samples of Best Hard Fine Para, tested for comparison, were 2,276 lb. and 2,312 lb. per square inch, respectively.

EFFECTS OF TAPPING ON TREES.

It was at one time believed that tapping had the effect of withdrawing food reserves (starch) from remote parts of the tree, for example, from the roots, and that in the course of time we might be faced with serious debility in the trees as a consequence. Our investigations have shown that the depletion of starch cells is usually very local, and that no such apprehensions need be felt. At the same time, the evidence with regard to bark renewal is in favour of a small number of tapping cuts and careful and moderate tapping.

WINTERING TREES.

In Ceylon, rubber trees are generally rested at leaf fall, but the probabilities seemed to be that, regarded from the point of view of the welfare of the trees, spring was the proper time to rest them. Our investigations have shown this to be the case; as it is when leaf is being renewed in spring that the food reserves of the tree are most heavily drawn upon by nature. No depletion

of starch cells occurs at leaf fall. The call upon the food reserves of the tree is most severe during the production of new leaves.

THE "DESCENDING INCREMENT."

What may be called the "descending increment," that is, the increase in the flow of latex and resulting weight of dry rubber as the tapping cut descends the tree, has been explained by the discovery of the fact that the rows of latex vessels increase in number as we descend the tree, and that this increase has no direct relation to the increase in girth. In some cases the number at ground level was nearly double that at a height of two feet. From there upwards the rows decrease, but not to the same extent. These discoveries not only explain a circumstance of which many planters were aware, but may possibly lead to modifications in tapping which are as yet not contemplated.

A list of Bulletins that have been issued is annexed.

LIST OF BULLETINS ISSUED.

No.	Subject.
1	The Effect of Tapping on the Movements of Plant Food in *Hevea Brasiliensis.*
2	The Effect of Tapping on the Movements of Plant Food in *Hevea Brasiliensis (continued).*
3	Seasonal Variations in the Movements of Plant Food in *Hevea Brasiliensis*
4	The Physiological Effects of Various Tapping Systems under Investigation at the Experiment Station, Peradeniya: Part I.
5	Progress Report on Vulcanization and Testing of Samples at the Imperial Institute.
6	The Physiological Effects of Various Tapping Systems under Investigation at the Experiment Station, Peradeniya: Part II.
7	The Physiological Effects of Various Tapping Systems under Investigation at the Experiment Station, Peradeniya: Part III.
8	Seasonal Variations in the Movements of Plant Food in *Hevea Brasiliensis*
9	Vulcanization Tests.
10	Report from PROFESSOR WYNDHAM R. DUNSTAN on Samples Prepared by MR. L. E. CAMPBELL, Rubber Research Chemist.
11	Variability in Rubber Manufacture.
12	Progress Report of the Rubber Research Chemist.
13	Investigation at the Imperial Institute on Samples Prepared in Ceylon.
14	On the Variation in Number of Latex Vessels present in *Hevea Brasiliensis* at Different Heights from the Ground.

CLEAN WEEDING ON RUBBER ESTATES.

A. H. MEAD.

In comparing weeding costs with Ceylon it must be remembered that in S. India we lose a large proportion of our leaf in the wet weather, and this very materially increases the weeding bill, and also for some reason or other

weeds are infinitely more persistent in S. India than they are in Ceylon, as many a Ceylon man has discovered to his sorrow.

However, I do not wish to write about the cost of weeding this or any other property, but to record our experiences and the conclusions we have come to.

Firstly, in our opinion, contract weeding stands condemned *in toto*. We look upon it as the hall-mark of inefficiency, and the best that can be said for it on a clean and cheaply weeded estate is that it is a bonus to labour. No native contractor that I have met has the foresight to lose money for a prospective profit, and the amount of expenditure for clean weeding varies each month and during each month.

Monthly weeding is simply a convention, and would be an excellent institution if all weeds refused to grow, flower and seed down in a shorter period. Unfortunately, it is not the case, and to eradicate one particularly persistent species I have had to weed as many as four times a month.

We were particularly bad with a weed known in Ceylon as "Korunegala daisy," and monthly weeding seemed to have no effect on it, but shortening the round to a fortnight simply wiped it off the face of the earth, and I have not seen a specimen on this group for a long time.

Another weed comes up lavishly two years after a clearing has been burnt off. I have never seen it flower, and it never appears again.

Our worst weed, known locally as "Manale cheera," is very local in its distribution, and I have never met it in any other district, but it was recognised by a Malaya planter, who told me it was impossible to eradicate, and also by an official in the Agricultural Department, who informed me that it had been the subject of a Government investigation, and that eight-year-old seed showed undiminished germinating powers! We have got it tame, but I calculate that it cost us £1,000 on this group from first to last.

The late JOSEPH FRASER's dictum, "Every weed before it seeds" cannot be beaten, but it is necessary to know every bad weed by sight, and how long it can be left in safety.

Dry weather is often much neglected, and is of utmost importance. Any seed let down in the dry weather will most certainly germinate with the first rains, whereas in monsoon weather seed may be imperfectly ripened and have poor germinating power. One difficulty in rubber is that the leaf-fall covers a multitude of sins, and weeds are probably more commonly missed then than in the rains. If the soil is inclined to bake, as is generally the case, coolies are very apt to break off a weed and leave a very healthy and deep-growing root to grow and flourish. For this reason I usually advocate an especially careful and thorough weeding at the beginning of the dry weather, and find that it often saves me the necessity of one or more rounds in the course of the next two or three months.

There are only two rational ways of disposing of weeds, i.e., burying or burning, and in both cases it pays to do it properly.

Weeding pits are objectionable, and usually neglected, thus forming distributing centres for seed. Another source of trouble is a jungle boundary, and I strongly advocate a boundary drain to stop seed being washed down into the estate.

In cleaning up any particularly bad land I find it a good practice to fork and cultivate frequently as soon as the weeds appear to be slackening off.

There is no immunity from weeds until all the seed that is going to germinate has done so, and the resulting weed has been removed.

One of the worst features of contract weeding is that weeding coolies are scattered all over the estate, and supervision is impossible. For this reason alone it is a marvel to me how the system has survived.

Every division on this property keeps a weeding book and the date on which each field is started and finished. The cost per acre, etc., is entered up. The divisional returns are entered up every ten days in my office, and I have a complete record of all the estates' weeding for the last five years.

It is interesting, looking through the above record, to see how costs have come down. The most expensive round of weeding on an estate in 1912 was Rs. 5 as. 0 p. 7. The cheapest in 1916 is Rs. 0 as. 1 p. 9. My cheapest field this year is a 400 acre block of rubber now four years old, and beginning to get help from the shade, which has cost Re. 1 as. 3 p. 7 an acre to weed for the half-year just ended. Needless to say, this field has been clean weeded from the start.—INDIA-RUBBER JOURNAL.

CACAO CAKE.

Cacao cake, a by-product from the manufacture of cocoa, has been imported into Denmark. These experiments were carried out in 1911, 1912 and 1913 with two lots of 10 cows each; 3 lb. of cacao cake in 1911 replaced 2 lb. of a mixture of ground-nut and soya bean cakes in the ration. The milk yield was reduced by 2·64 lb. per cow per day in consequence, the experimental period being 56 days; the fat percentage was increased from 3·26 per cent. to 3·51 per cent., but this was not sufficient to compensate for the decreased yield.

In 1912, 1·54 lb. of cacao cake was added to the cake and roots ration of 10 cows for 67 days, the control cows' ration being unchanged. The cacao cake addition reduced the milk yield by 1·2 lb. per cow per day and increased the average fat percentage over the period from 3·27 to 3·42 per cent., an amount insufficient to compensate for the decreased yield.

The 1913 experiments were carried out on similar lines to those in 1912 (the addition of cacao cake was raised to 2 lb. per cow per day) and with similar results.

In addition to the detrimental effect on milk secretion shown by the above experiments, veterinary investigations in 1912 and 1913 showed the cake to be poisonous. It is, therefore, not recommended for milk cows.—

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COCONUTS.

BEES AND COCONUTS.

A. H. RITCHIE.

A very interesting point is brought out by MR. FRANK P. JEPSON, the Government Entomologist of Fiji, in a recent circular giving an account of a tour of the coconut sections of that colony. As is well known the coconut bears two kinds of flowers: male flowers which give the dusty pollen and female flowers which look like tiny nuts at first, not complete flowers, having both male and female organs present, as is the commoner state of affairs. On further examination, too, we will notice that the male flowers and female flowers on the same stalk or as botanists would call it "spadix," never mature at the same time. The males open soon after the spathe or covering bursts and the females not till later. Generally too, we find only one set of flowers open, or ready to fertilise or be fertilised, on a coconut at one time. This is one of nature's devices which are calculated to guard against inbreeding or self-fertilisation. It insures that fertilisation from another coconut palm must take place. DARWIN's experiments along this line are well known. The pollen must then be conveyed from the male flowers of one tree to the female flowers of another by one or two agencies—wind or insects. We notice that on certain trees, indeed on most trees, that a high percentage of the small nuts fall to the ground—using the term nuts as the growers use it meaning the undeveloped female flowers at this stage.

While there may be other causes, JEPSON puts forth the idea and rightly I think, that this is due to their escaping pollination. We all know that with melon and pumpkin, fruit will not set unless pollen is transferred from the male to the female flower by insects or hand; the usual plan by market gardeners being to nip off and place a male flower shedding pollen against the female flower. When this is done correctly, almost every female sets and a fruit is produced.

JEPSON noticed on those coconut estates where bees are kept that the bees swarmed around the open inflorescences in great numbers and further that the yield on these plantations was phenomenally high. Palms of 5 and 6 years bore heavy crops and bunches were well filled. He concludes that the general introduction of bees on to coconut plantations is well worth a trial in Fiji. It would be interesting to have the observations of the growers in Jamaica on this subject.—JOUR. JAMAICA AGRIC. SOC.

THE PROSPECTS OF COCONUT OIL AND PALM OIL.

The following is an extract from the report of the Committee appointed by the Secretary of State for the Colonies to report on the edible and

oil-producing nuts and seeds of the West African trade:—

So far as present conditions indicate, there is not much likelihood of the supply of animal fats from either cattle, sheep, or pigs becoming sufficiently abundant for the price to fall seriously and affect that of palm-kernel oil. Indeed, so far as such fats are concerned, the indications are all the other way. The consumption of fats is steadily and largely increasing, while the world supplies of live stock are likely to fall below, rather than to exceed, the demand.

As regards coconut oil and palm-kernel oil the position is different. Both these oils are similar in composition and properties, and for practical purposes are interchangeable.

Effective competition by one oil of a suitable quality with another does not, of course, necessarily mean that the other will not continue to be used at a price, and it is only if the price fell below that of profitable production that the oil would go out of use altogether. As regards coconut oil and palm-kernel oil, the ruling price is affected by both, but predominantly by coconut oil in so far as the present world's supply of the former is double that of the latter. The production of both is increasing, and it would be rash to say which has the greater possibilities. But only if the cost of one or the other is suddenly reduced to a quite different level it is likely to affect the general position, and the Committee do not anticipate that this will take place on a sufficient scale to change the whole nature of the situation within the next decade.

Competition from palm oil produced by improved methods is another possibility and one of which there is distinct likelihood. So far, however, as the importation of kernels is concerned, an extended use of palm oil obviously implies a supply of kernels. The present difference in price between the two may be altered, but obviously the amount of kernels available is not likely to be diminished as it might be by other competition.

A more detrimental competition is likely to be furnished by some of the oils naturally liquid at ordinary temperatures (Q. 2,481-83, 4,801-6). The treatment of oils with hydrogen has been introduced with the effect of converting into solid fats those oils which are now liquid at ordinary temperatures, and of raising the melting point of solid fats. Thus "hardened" cotton seed oil is already largely used for making "compound lard"—which indeed in some cases contains no lard, properly so-called, at all. In so far, therefore, as any distinctive taste can be removed by refining, or other difficulties overcome, cotton-seed oil, linseed oil, soya bean oil, and even whale oil, may soon become largely used in the manufacture of margarine. Indeed, it is probably the case that whale oil has already been so used on the Continent of Europe. It should also be remembered that the immense quantities of linseed and cotton-seed available make such competition formidable, despite their comparatively low percentage of oil.

Lastly, it is possible that new varieties of nuts from other parts of the world may be placed on the market. In Central and South America, the cohune and babassu nuts have lately been engaging attention (Q. 1,337–39, 2,469–71), and the Committee have been informed that other varieties of oil-producing nuts may become available. At present, owing to the shortage of labour in the countries of its origin, there are difficulties in collecting an adequate supply of the cohune nut, and in the case of both nuts the thick shell requires special machinery for cracking.

Taking the question as a whole, the data do not exist for forming any estimate on which a confident prediction can be based. An increasing use of hydrogenated oils, however, seems certain, and is, indeed, already beginning. Palm oil so improved in quality as to be edible is a distinct possibility, but is not likely to be available in large quantities for some years. The cheaper production of copra is also a possibility. On the other hand, the world's consumption of edible fats is rapidly increasing and is far from satisfied. Moreover, even if oils at present absorbed in non-edible products are made available for edible uses, the demand for the non-edible products is also very great. Hence, in the absence of some new source of supply hitherto entirely unknown or at least untapped, the result may well be that the prices of edible and non-edible products will approximate. But the approximation may take effect partly through a rise in the price of the latter and not wholly through a fall in the price of the former.

The general conclusion of the Committee, therefore, is, that the future for palm-kernel oil appears sufficiently secure to warrant any reasonable efforts to establish the trade in palm kernels in this country.

THE POISONOUS PROPERTIES OF CACAO SHELLS.

It appears that poisoning of horses may follow the feeding of large quantities of cacao shells. In a Danish case the rations of horses contained 2¼ lb. of the shells on several occasions; one animal died after a short illness from paralysis of the heart, the symptoms being sweating, exhaustion, unsteady gait and yawning. In a German case several horses fell ill after being fed on the shells from a chocolate factory, and one died. Poisonous effects from the shells were obtained experimentally with rabbits, guinea pigs, and human beings.

The poisonous properties are due to the alkaloid *Theobromin*, the shells containing up to 1·11 per cent., but on the average 0·76 per cent., of this substance, according to König, and some investigators maintain that the roasting process increases the content of this alkaloid. If 2¼ lb. of the shells are fed at a meal it would be possible for the system to contain ½ lb. of *Theobromin* after 4 days. No experiments with *Theobromin* on horses are on record but half this quantity of the related *Caffein* has killed horses and cattle and one-twentieth pigs and goats.—JOURNAL OF THE BOARD OF AGRICULTURE.

[Cacao shells consist of the thin covering of the bean.—Ed.]

TEA.

A STEM DISEASE OF TEA.

T. PETCH.

Our frontispiece illustrates a stem disease of tea which has existed in Ceylon for several years though the damage caused by it has been only slight.

The illustration shows a tea stem attacked by the fungus, *Aglaospora aculeata*. In general, this disease attacks a side branch and kills it back, the extent of the penetration of the fungus being indicated by the discoloration of the wood which is usually uniformly browned. When the branch is dead, the fructification of the fungus is developed beneath the bark, which is slightly raised and cracked in consequence, and the apex of this fructification bursts through the bark and projects like a small black thorn. As a rule numbers of these thorns are produced, arranged more or less in concentric rings on a patch two to three inches long.

The disease is readily distinguished by the presence of these black thorns. Dead branches which exhibit them should be pruned off and burnt, care being taken to prune into sound wood. If left unchecked the fungus travels into the main stem, as in the example photographed, and kills the bush. The illustration shows the elevation of the bark over the fructification, each with a black point in the centre.

CEYLON TEA-BOX WOODS.

F. LEWIS, F.L.S.

[At a recent meeting of the Committee of Agricultural Experiments, attention was directed to the increased cost of tea boxes and the possibility of utilising native timber, instead of the imported Momi chests. It was stated that Momi chests, for which the pre-war rate was 87 to 90 cents, now cost up to Rs. 2·40. In view of possible action, it has been thought advisable to reprint a paper which was published by Mr. F. Lewis, then Assistant Conservator of Forests, Ceylon, in the Journal of the Society of Arts, and reprinted in the Tropical Agriculturist for November 1898, at a time when conditions similar to the present prevailed. It may be noted that some of the timbers mentioned, e.g., Bombax, have been rejected on the ground that the chests made of them are frequently attacked by borers.—Ed.]

The increasing export of tea from Ceylon, which must now be regarded as having more than fully taken the place of the island's former staple—coffee, has developed a correspondingly large trade in woods suitable for the manufacture of boxes for the packing and transport of the prepared article. Some notion of the volume of wood required yearly may be arrived at from the fact that, assuming all the tea exported from the island to be packed in 100 lb. chests, the total number of chests for one year's export alone would be over a million, or, roughly speaking, upwards of 18,000,000 superficial feet of planking.

Of this vast quantity, for some years past a great proportion of the wood has come from Japan, as both planters and merchants found by experience that the Japanese tea box was not only very neat, but it had the superior advantage over the locally made article in possessing great equality of weight. The importance of the last consideration cannot be too highly valued by the planter, as fluctuation of weight would in all cases lead to the contents of the box being emptied out and re-weighed for obvious reasons, entailing not only additional cost and delay, but a serious loss by waste.

London importers also raised objections to certain Ceylon wood packages on the grounds of "tainted teas," implying thereby that the teas themselves had acquired a taint from the smell of the outer wood package. notwithstanding the fact that between the wood and the tea itself is an air-tight envelope of lead. A still further objection was raised, that certain woods corroded the lead lining and introduced poisonous matter.

It is, perhaps, foreign to the purpose of this paper to enter into any discussion as to the merits of the above objections, as, unfortunately, those most interested accept as final what is told them by their London constituents.

Now that the importation of tea-box wood has declined from Japan, owing to the late Chino-Japanese war, the demand in Ceylon for local woods for cases at once increased, and the demand for soft light woods rapidly began to manifest itself. The trade is practically in native hands, and for this reason the planter is often placed at a serious disadvantage, as he is absolutely ignorant of the extent of seasoning his packages have received, and very frequently is equally ignorant as to the materials themselves.

The trader is interested chiefly in obtaining woods that are light, and these he buys from people who have wood for sale; and so long as these will *float*, the log dealer will invariably find a ready sale for his produce, no matter if it is composed of all sorts or of wood, green or dry. It will be further understood that the log dealer—for so he is—buys his wood wherever he can get it near navigable streams, and, as these are very subject to periods of flood as well as periods of non-navigability, it follows that he must often be for months unable to move his wood, during which time it has either stranded in the stream or in the forest just as it was felled. Such conditions are not conducive to improved seasoning; and, naturally, wood exposed in this manner to tropical atmospheric changes cannot but suffer in turn. It is, moreover, remarkable that tropical soft woods are much more easily affected than woods imported from temperate zones. Finally, in Ceylon, the forests cannot be regarded as possessing any large extent of gregarious woods; in other words, pure forests do not exist, so that the log dealer can only adopt his standard of lightness as his rule for selection and not that of species only. It is not to be wondered at, therefore, that our locally-made tea boxes are mixed as regards their composition, and equally mixed as regards their specific weights.

That much could be done to remedy this state of affairs goes without saying, and it is to be deplored that so large an industry suffers from want of systematic arrangement, which would go far to reduce the evils complained of, if not to absolutely eliminate it altogether. It is proposed to give a short list of local timbers in use in Ceylon, with their local names added, as in that country the native name is more generally applied than the scientific.

MAGNOLIACEÆ.

No. 1. *Michelia nilagirica* Zenk. Sinhalese—*Wal-sapu.*

This is a purely hill species and is rarely found below 4,000 feet altitude, and not over abundant. It is demanded owing to the neatness of package it affords and beauty of wood.

No. 2. *Michelia Champaca* L. Sinhalese—*Sapu.*

An introduced species, found chiefly in gardens, where it was probably introduced many years ago for the sake of its highly scented flowers which are used as offertories at Buddhistic shrines. The wood is greatly prized and only occasionally found in use for tea boxes, for which it is far too good.

ANONACEÆ.

No. 3. *Cyathocalyx zeylanicus* Champ. Sinhalese—*Ippatta.*

Fairly abundant plant, and found through most of the wet forests in the Western and Sabaragamuwa Provinces from practically sea level to 2,000 feet. It is a favourite wood, as it grows very straight and only branches high up so that it is easily worked.

No. 4. *Xylopia parvifolia* Hook f. and Thoms. Sinhalese—*Netawu.*

Like the last, is a wet forest plant; common, but not particularly abundant. It is, perhaps, more common in the Gillimali country, at the base of Adam's Peak, than further to the east. It affords a nice, clean-looking wood, but is not in very high demand, as it is said to be too heavy.

GUTTIFERÆ.

No. 5. *Calophyllum tomentosum* Wight. Sinhalese—*Kina.*

A hill species and a favourite wood for building purposes in general and occasionally used for tea boxes, but unsuitable on account of weight. A beautifully marked wood and very durable.

DIPTEROCARPACEÆ.

No. 6. *Doona congestiflora* Thw. Sinhalese—*Tiniya.*

A large tree and found growing gregariously in many of the wet forests of the island. It affords a timber much like cedar in appearance, light, and easily worked, and, therefore, is in great demand.

No. 7. *Vateria acuminata* Hayne. Sinhalese—*Hal.*

A large handsome tree, widely distributed in the Western, Southern, and Sabaragamuwa Provinces, but rarely found above 3,000 feet altitude or out of the very wet limits. The wood is in great demand, as it is very easily worked, light and lasting. This tree runs some risk of becoming destroyed altogether, as the natives strip off the bark from young and old trees to assist in stopping fermentation in toddy, for which purpose it is freely used, to the destruction of the tree. The fruit is also eaten, so that the tree has many vital enemies to its existence.

MALVACEÆ.

No. 8. *Bombax malabaricum* DC. Sinhalese—*Katu-imbul.*

An enormous tree scattered over the greater part of the west of Ceylon up to 2,500 feet, above which it becomes very scarce. It is found in the dry districts towards the South, where it attains a stem circumference of 15 to 18 feet. Owing to its great lightness and the neatness of box turned out from the wild cotton tree, it is a great favourite and commands a good price. The natural reproduction of the tree is not good so that in its wild state the tree stands some risk of being very much over-worked.

No. 9. *Cullenia excelsa* Wight. Sinhalese—*Kaluboda.*

A common tree in all the wet forests up to 4,000 feet and occasionally a gregarious plant. It has only of late years come into favour as a tea-chest wood, and bids fair to become popular, as the timber is light and easily worked and rather pretty.

SIMARUBACEÆ.

No. 10. *Ailantus malabarica* DC. Sinhalese—*Wal-billin or Kumbalu.*

A large lofty tree, but found in no great abundance. It yields a very soft wood, and is easily worked. In parts of the Kegalla district the local carpenters pass off a good deal of this wood as wild cotton, so as to secure a sale for it, owing to the popularity of the latter species.

BURSERACEÆ.

No. 11. *Canarium zeylanicum* Bl. Sinhalese.—*Kekuna.*

A very large forest tree and found chiefly in rocky ground on the wet zone up to about 2,000 feet. Very common in suitable places in the Western Province, especially in the Pasdun Korale. The wood is very light and easily worked, but is so soft that it decays very quickly. The bark contains a pungent, balsamic resin that is said by the natives to be a valuable specific against snakes if burned in a house. The seeds are eaten, and in flavour are not unlike walnuts.

MELIACEÆ.

No. 12. *Melia dubia* Cav. Sinhalese—*Lunu-midella.*

A large and conspicuous tree with crowded bi-pinnate leaves that form tuft-like terminations to the long thin branches. It is not a tree of very general distribution in Ceylon, as it seems to prefer certain soils, out of which it does not flourish. It is cultivated in the Kegalla district both by natives and Europeans, and, owing to its rapid growth, it is a favourite. The wood is in very great demand, both for its suitability for the making of out-riggers for native boats and for ceiling boards and also tea boxes. It is light in weight, easily worked, and durable. This wood has been tried for fuel purposes, but is not found to be a success as such.

The cultivation of *Lunu-midella* is profitable, as in eight years the tree attains sufficient size as to be saleable.

No. 13. *Chickrassia tabularis* A. Juss. Sinhalese—*Hulan-hik.*

A moderately large tree, but not common. It has been used as tea-box wood, but is not adapted to this purpose, for which it is much too good owing to its weight. It is a very ornamental wood and suitable for carving.

No. 14. *Cedrela serrata* Royle.

This is an introduced timber tree, and is known as "Red Toon." Its introduction has been quite of recent years, and its success has been somewhat questionable, owing to the young plants being subject to the attack of a "borer" that quite destroys the part attacked, and often the whole tree. The wood is a favourite for tea chests, and at one time was largely imported into Ceylon for this special purpose.

OLACINEÆ.

No. 15. *Lasianthera apicalis* Thw. Sinhalese *Urukannu.*

A large handsome tree, the young leaves of which have a conspicuous coppery hue, and highly polished upper surface. It is abundant in parts of the Western Province, and ascends to a considerable altitude in the wet zone. The wood is not in great favour, chiefly because of its weight, but while it can be obtained easily, carpenters readily buy it for local use.

TRIMEN gives *Uruhonda*, *Urueta* and *Kospana* as further native names, but it is more generally known by the name given above.

CELASTRACEÆ.

No. 16. *Kokoona zeylanica* Thw. Sinhalese *Kokoon* or *Kokoon-potu*.

A very common tree in the very wet forests near the foot of Adam's Peak, and in the districts extending towards the west coast.

This wood is not very favourable, because of its splitting so freely, but is suitable for small cases.

ANACARDIACEÆ.

No. 17. *Mangifera zeylanica* Hook. f. Sinhalese *Walamba*, *Etamba*. (*Amba*, lit. a kidney).

A large and handsome tree of wide distribution, extending from the confines of the dry country in the south-west, all over the wet forests up to 2,500 feet, after which it becomes scarce. The tree attains a very large size with a long clean stem. The wood is pale white, soft, and easily worked, and is in large demand for cases.

No. 18. *Semecarpus subpellata* Thw. Sinhalese *Maha-badulla*.

A moderately large straight tree, found in all the very wet forests of the Western Province and Sabaragamuwa, particularly within the water-shed of the Kaluganga river.

This wood is in particular demand for tea chests, though it is said to be one of the woods that corrode tea lead or the lining used between the tea and the wood.

No. 19. *Semecarpus coriacea* Thw. Sinhalese *Badulla*.

A common tree, found over most of the hill country above 4,000 feet. This wood sometimes used, but it is considered too bad owing to the risk there is of getting any of the "milk" (Sin. *Badulla-kiri*) on the skin, as it at once sets up a violent inflammation. It is possible that two or more than those mentioned of this genus are used, as the Sinhalese name *Badulla* extends to both the large as well as small forms of *Semecarpus*, and the wood coming within the "light" class would be accepted for the purpose intended.

No. 20. *Campnosperma zeylanicum* Thw. Sinhalese *Aridda*.

A large dark-leaved tree, and in many of the wet forests in the vicinity of Adam's Peak it is a gregarious species. In Gillimali—at the foot of Adam's Peak, eight miles from Ratnapura—these trees are found in great abundance, attaining a girth of seven feet. It is in very high favour for tea-chest manufacture, as it affords a light, easily worked, clean-looking wood, possessing all the qualifications necessary to commend it to the planter.

RHIZOPHORACEÆ.

No. 21. *Anisophyllea zeylanica* Benth. Sinhalese *Welipenna*.

A tree attaining considerable size, and found in moderate abundance in all the wet forests of the western half of the island, up to 2,500 feet, after which it becomes scarce.

It is occasionally used for tea boxes, but is not a favourite for that purpose, as it is too heavy.

DATISCACEÆ.

No. 22. *Tetrameles nudiflora* R. Br. Sinhalese *Mugunu*.

A very large tree, distributed mostly through the country having the intermediate rainfall between the wet and dry zones. The wood is very soft and light, and occasionally mixed up with harder kinds in the manufacture of chests.

CORNACEÆ.

No. 23. *Mastixia tetrandra ?* Clarke. Sinhalese *Diya-taliya.*

A large wet-zone tree, and found in abundance in the valleys of the Kaluganga water-shed. The wood is much sought after, and is suitable owing to lightness.

RUBIACEÆ.

No. 24. *Sarcocephalus cordatus* Miq. Sinhalese *Bakmi.*

A rather common tree in the wet ground, with exceedingly large stipules. The wood is light and soft but not in great favour.

SAPOTACEÆ.

No. 25.—*Chrysophyllum Roxburghii* G. Don. Sinhalese *Láwulu.*

A moderately large tree, scattered sparingly over the wet zone, and occasionally used for tea-box manufacture, but not in great favour, as trees of sufficient size are difficult to procure.

No. 26. *Palaquium grande* Engler. Sinhalese *Mihiria, Kirihimbilia, Kirihiria.*

A very large, thick, brown-barked tree, of wide distribution in all the moist forests of the country, up to about 4,000 feet altitude. It is a favourite building wood on estates, and is often used for tea chests. The wood is reddish in colour, dark and close.

APOCYNACEÆ.

No. 27. *Alstonia scholaris* R. Br. Sinhalese *Rukattana.*

A very large, tall tree with pale grey stem and dark whorled leaves, found throughout the low country up to 3,000 feet, except in the dry zones. This wood is much sought after owing to its extreme lightness, and is greatly in use for the manufacture of coffins. In colour the wood is white, and when freshly cut is offensive in smell.

MYRISTICACEÆ.

No. 28. *Myristica laurifolia* Hook. f. and Thoms. Sinhalese *Malaboda, Rerimarwara.*

A very common tree in all the wet forests up to 5,000 feet, and frequently found on the banks of streams in the dry zone. The wood, if carefully seasoned, affords a splendid packing case material, but the difficulty in drying the timber is against its popularity. It splits freely and is of a pale yellow colour.

No. 29. *Myristica Horsfieldia* Bl. Sinhalese *Ruk.*

A large tree fairly abundant in the moist zone, with a particularly sweet-scented flowers. The wood very much resembles the last in appearance, but is much more heavy, and for this reason is rarely used in the manufacture of tea boxes.

No. 30. *Myristica Iriya* Gaertn. Sinhalese *Iriya.*

A common tree on the banks of rivers and streams, and often in swampy places. It has a bright pink pericarp, with seeds enclosed entirely by a scarlet aril.

The wood strongly resembles that of the last named species, but is lighter and is in demand.

LAURACEÆ.

No. 31. *Cryptocarya membranacea* Thw. Sinhalese *Tawanna, Walkos.*

A wet zone tree, and abundant in the Gillimali district at the foot of Adam's Peak and towards the "Haycock," on the borders of the Southern

Province. A yellowish coloured wood, close-grained, and well adapted to tea box manufacture, but not particularly used owing to weight.

No. 32. *Machilus macrantha* Trimen. Sinhalese *Ululu*.

A very large tree found in some abundance in the Avisawella district and towards Adam's Peak.

It is a favourite tea-box wood, as it is easily worked, and of a light weight. Dry saw-dust of this wood is faintly aromatic in smell.

No. 33. *Litsea chinensis* Lam. Sinhalese *Bomi*.

A common tree throughout the island up to 2,500 feet, and well known to all local carpenters. The wood is in great favour for flooring boards as it is capable of taking a superior polish. Frequently used in the tea-box trade.

No. 34. *Litsea zeylanica* Nees. Sinhalese *Kududawula*.

A common tree in the hill country, between 2,000 and 4,000 feet, and in great favour not only for the tea cases but for door frames, sash bars, dados, and the like. The wood is light in weight, and will take a high polish of a yellowish orange colour.

EUPHORBIACEÆ.

No. 35. *Aleurites triloba* Forst. Sinhalese *Tel-kekuna*.

An introduced tree and common enough in native gardens, where it is cultivated for the sake of the oil that is extracted from the nut. Sometimes, but very rarely, used in tea-case manufacture. The wood is white, soft and light.

URTICACEÆ.

No. 36. *Ficus nervosa* Heyne. Sinhalese *Kalamaduwa*.

A large-leaved tree, and occasionally found in the forests of the wet zone. The wood is soft and light but decays quickly.

It is probable that a few more species of the genus *Ficus* get mixed up with other light soft woods in tea-box manufacture, as they are easily procurable in common with so many of the woods mentioned above, but it is undesirable to record any doubtful examples. The list given includes most, if not all, of the recognized tea-box woods, and to which, but for the ignorance of the traders themselves, many more might be added.

The culture of the woods for this special trade may in course of time be tried in Ceylon, as the wants of the planters make suitable wood more and more scarce; but it is noteworthy that no invention has yet been brought out by which compressed wood could be used instead of the present very laboriously manufactured article.—JOURNAL OF THE SOCIETY OF ARTS.

CONTROL OF IMPORTED TEA SEED.*

DR. C. H. BERNARD AND DR. J. J. B. DEUSS.

In recent years there have been numerous complaints in Java about the quality of the tea seed imported from British India. Although formerly seed arrived in good condition and gave good germination results, the quality has gradually deteriorated as the bulk of the imports increased. In the planting seasons, 1910–11 and 1911–12, the seed was particularly bad and there are not a few planters who received big quantities of seed with more than 50% in wretched condition: cases have been cited where lots of 100 to 200 maunds gave even less than 20% germination.

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* *De controle der ingevoerde theezaden—Mededeelingen van het Theeproefstation, No. XXII.*

TESTING.

The testing is done as follows:—Samples, of 100 seeds, are taken from as many cases as possible. The seeds are thrown into water, each sample separately and if no particular irregularities are noticed in the percentage of sinkers or in the external appearance of the seed, the samples of one invoice are lumped together. At first we counted the sinkers immediately, after half an hour, an hour and two hours, but we have since learnt that it is enough to count them immediately and after two hours, and we shall pursue this simpler method in future.

On some Java estates the floaters and sinkers are separated after being in the water for 12 hours or more, but we consider this too long, because seed which sink after 10 or 12 hours generally contains a very heavy percentage of rotten or mouldy kernels, and although submersion for two hours is perhaps a little short it seems to us sufficient for drawing conclusions from.

By this means we obtain first of all a classification according to specific gravity, which, however, is not conclusive though in the majority of cases sinkers are of better quality than floaters, but experience has shown that often a big percentage of floaters are good and that very bad seed can sink; thus for example we once found in a case containing 100% rotten or mouldy seed about 30% that sank after two hours in water.

For the above reasons we reserved say, 2/3rd of the sinkers and 1/3rd of the floaters for sowing, while the balance were opened and carefully examined. This enabled us to establish a second check and to divide the seed again into:

good, i.e., with healthy germ and the kernels hard and completely filling the shell;

good (?) i.e., doubtful, with the germ sometimes a bit yellow and the kernels dry, a little soft, or perhaps yellowish;

bad i.e., 1, a little mouldy or rotten;
2, very much dried up;
3, utterly rotten, mouldy or empty.

It is possible that our scheme of control is rather severe and we realize that seed is often considered good that we should class as doubtful, but still we have thought it desirable to make the distinction because even if the doubtful seeds do germinate they mostly produce backward plants which do not shew normal development. At the same time it would be quite wrong to throw away these doubtful seed as *a priori* useless.

The seed described as somewhat mouldy or rotten and those dried up must be classed as bad, even if the harmful organisms are only slightly developed, because during the time that these seeds take to germinate, the fungi and bacteria will have also developed in excess in the interior of the shell, whether placed in earth or damp sand, and have caused a far advanced or total destruction of the contents of the seed. Certainly, some part of this bad seed will germinate, but only a small quantity of plants will be obtained, in addition to which the kernels will always have been more or less affected and the plants will accordingly have some abnormal development.

Later on we shall be able to have a third check, as soon as we know the number of germinated seed and the appearance of the plants, and eventually a fourth form of check, because we hope to keep in touch with the planters who receive the seed, and shall ask them to keep us advised of the results obtained.

The 99 examinations we have made have given the following results:—

Below			50%	sinkers	...	10
From	50	to	60%	,,	...	8
,,	60	to	70%	,,	...	20
,,	70	to	80%	,,	...	20
,,	80	to	90%	,,	...	23
,,	90	to	100%	,,	...	18
						99

These figures form a possible basis for determining the percentage of good seed, but as already mentioned a certain number of sinkers are always bad while a certain number of floaters can, in proportion to the goodness or otherwise of the packing, give good results. We therefore think it desirable to use our second check method as a basis. It would then be possible either to take only the seeds classed by us as absolutely good, which would be abnormally strict, or one might add to the good seed a part, say half, of the doubtful, or lastly mix up the good and doubtful together. It is this last method that we have adhered to, because it seems to us nearest to actual conditions. As a rule the figure thus obtained is a trifle lower than that of sinkers alone, but the first is in an almost constant ratio to the second, and appears to be more in agreement with the percentage of germination. Seeing that, in addition, we carry out our control pretty strictly as regards doubtful, and especially as regards slightly mouldy seeds, which we class as bad if there is the slightest trace of mildew on the kernels, it can be taken for granted that if part of the doubtful seeds give poor results, part of the slightly mouldy ones are likely to give good plants (especially if they germinate quickly), and these plants will not be in any way injuriously affected by a little mildew and will compensate for the loss of those doubtful ones which have not germinated.

The following figures have been obtained by adding together the good and doubtful seeds in our 99 experiments:—

Below		50%	good +	good (?)	seed	... 8
From	50 —	60%	,,	,,		... 13
,,	60 —	70%	,,	,,		... 26
,,	70 —	80%	,,	,,		... 35
,,	80 —	90%	,,	,,		... 13
,,	90 —	100%	,,	,,		... 4
						99

It would undoubtedly be best to take as a basis our third check method (percentage of seed that have germinated after a given time), but we require data at once and cannot wait for several months before coming to a decision, so that the third check must wait, to be of use later on for comparison.

PACKING.

This point, packing, is in fact of the greatest importance and we consider that one result of our preliminary investigation is the proof that this point has the greatest possible influence on the quality of the seed as it arrives in Java. The causes of the bad seed in the past years have been sought far and wide, and suggestions have been made of seed harvested unripe, of disinfection of ships, of unhealthy mother trees and so forth, all of which contributory factors must not be lost sight of; but their effect is infinitely less than that of

faulty packing. It can be easily understood that, in view of the big demand for seed in the last year or two, there was a rush on the estates in Assam to get off the big quantities ordered, with the result that less attention was paid to packing, and a larger part of the seed arrived damaged.

The packing material and the manner of using it are of course of the utmost importance. Before everything, it is necessary that at the moment of despatch the seeds are not too damp, because if so it is impossible to regulate the humidity in the interior of the case, which has so much effect; we have seen boxes with too damp contents in which many seeds had germinated, or worse still, had become mouldy, and even the paper used as lining had become nearly disintegrated.

Three different materials are as a rule used for packing, i.e., charcoal, or clay in a dry powder, or fine sand, while sometimes all three are mixed in various proportions.

Charcoal is theoretically the best of the three, as it is easily obtainable in large quantities, can be powdered and dried to taste, and prevents mouldiness. As a rule the lots tested by us which were packed in charcoal contained a much smaller percentage of mouldy seed. But charcoal has one big defect; if it is used quite dry it dries up the seed owing to its own hygroscopic character, and in nearly all the lots packed in dry charcoal we found a large percentage of dried-up seed, which had to be classed as bad. If charcoal is artificially damped, there is the risk of going too far and obtaining a lot of germinated seed, whose roots as we noticed, were often some centimetres long, and as the charcoal gradually loses its humidity during the voyage these roots dry up and the seeds become valueless. It is quite certain that if the necessary degree of dampness is accurately obtained, the seed arrives in good condition, and we have come across several lots like this, containing more than 90% sinkers and 80% good seed. But this accurate degree of dampness seems very difficult to obtain, and generally the charcoal results are unsatisfactory owing to the large quantity of doubtful seed (of which many come up), and the dried up or germinated seed.

The above trouble seems easier to avoid with *yellow* or *grey clay* which is often used. Without doubt it is difficult to dry it as much as charcoal as it always retains some moisture which keeps the seed in good condition, and although it is true as we have often noticed, there is a danger of increasing the number of mouldy or rotten seed together with the greater danger from too damp clay, than from too dry charcoal, yet it is apparently easier to catch the happy mean with dry earth, which must be dry enough to keep powdery, but this powder must always be capable of being pressed into a lump with the fingers.

We cannot say it for certain, and we hope to pay much attention to the point in the future, but we think we may now assert that it is easier for the reasons given, to obtain a good packing material from clay, although theoretically charcoal is best. Only figures however based on a large number of shipments can settle this point definitely.

A well prepared mixture of *charcoal and clay* would perhaps have the advantages of both without the defects, and we have seen several lots thus packed, where the condition of the seed was excellent, even though the quantity of charcoal was generally speaking too small. Without doubt this packing will be adhered to after the mixture has been more carefully studied.

A few comparative figures will illustrate the effect of clay and charcoal under different circumstances: thus in two invoices packed in sufficiently damp charcoal we found 93 and 98% sinkers and 72 and 73% satisfactory seed (i.e., the total good and doubtful seed added together), while in two damp charcoal we found in one invoice 30% and in another 40% of germinated seed, of which many had roots several centimetres in length. We also tested a shipment of which some of the boxes were packed with very dry charcoal, and others in almost dry clay; the results were:—

In almost dry clay; the results were:

In clay:	78% sinkers—	71% good, 6·5% good (?).	22·5% bad.
In charcoal:	53% ,,	53% ,, 1·8% ,,	29% ,,

The increase will be noticed in the number of doubtful seeds, i.e., those with dried kernels.

In a mixture of clay and charcoal, with the latter in sufficient quantity, we found 76·85% sinkers and 70·90% satisfactory seed.

We have tested a few lots packed in fine dry *sand* and of various kinds, but we cannot give a definite opinion on this system, though it strikes us as bad in several respects; it has not the good points of powdered clay nor of charcoal, but we shall investigate the point further.—QUAR. JOUR. INDIAN TEA ASSOCN., Pt. 1, 1914.

THE USE OF FUNGOUS PARASITES IN SCALE INSECT CONTROL.

From the July number of the MONTHLY BULLETIN, California, it appears that some embarrassment has been caused to agricultural officers by commercial claims to successful treatment of black scale with a fungous parasite, a species of *Isaria*. This has led to a formal investigation by a committee of experts who report that they find no evidence of the success of artificial inoculation.

The following summary presents the conclusions reached on this matter by MESSRS. H. J. QUAYLE and A. R. TAYLOR:—

1. The effect of *Isaria* fungus growing under suitable conditions in a moist chamber, either in the laboratory or the field, was found to kill a fair percentage of the black scale.

2. The results in attempting to disseminate the fungus artificially under natural conditions in the field, at least at the season indicated, have been wholly negative.

3. From observations made in the various groves where the fungus has been disseminated commercially, there is absolutely no evidence, thus far, to show that the fungus has been of any importance whatever in checking the scales.

4. Where natural conditions are favourable for the development of the fungus, as in the districts contiguous to the coast in Santa Barbara County, the *Isaria* will kill more or less of the black scale, but the field where it would thrive cannot be greatly enlarged, if at all, by attempts at artificial dissemination.

5. From our recent experiments and observations as well as general observations made on this fungus since 1908, the writers feel justified in extending to citrus growers no hope that this fungus will keep their trees free from the black scale.—W. N. IN THE AGRIC. NEWS.

RICE.

THE HEALTHINESS OF RICE FIELDS IN ITALY.

O. BORDIGA.

The writer shows that the cultivation of rice has no injurious influence on health nor on the vigour of the race, whilst it yields a much greater income per unit area than that of other more important and more widely cultivated crops. Making use of recent resources of information he shows the progress and well-being from an econcmic, social and hygienic point of view that Italy has derived from this cultivation, and shows how devoid of serious foundation are the accusations against its unhealthiness.

The exportation of rice has been a source of continually increasing profit until the present crisis, as shown by the following figures:

Mean Annual Export in Thousands of Cwt.

	1891–1896	1908–1910	1911–1912	1913
Paddy ...	65	266	484	427
Cleaned rice ...	663	728	1,128	880

This corresponds to a value of about one million, in addition to the value corresponding to the home consumption, obtained from a crop occupying scarcely 361,000 acres.

The area under rice has diminished during the last 20 years. In 1875 it was more than 494,000 acres, in 1894 it was 408,000 acres and at the present time it reaches only 361,000 acres. The yield, on the contrary, has increased from 15,779,541 bushels=6,211,000 cwt. in 1894 to 9,578,000 cwt. at the present day. The total yield has therefore increased by about 54 per cent. and the yield per acre has increased still more, the actual figures being 15·22 cwt. per acre in 1894 and 26·53 cwt. per acre at the present time or an increase of 74 per cent. No othey Italian crop can even approach these figures, as shown by the following table:

Comparative Yield of Cereals in Italy in 1880–1884 and in 1909–1914.

	Yield in cwt. per acre.		Percentage increase.
	1880–84	1909–14	
Wheat	6·60	8·23	24·7
Maize	10·75	13·22	23·3
Oats	6·37	8·30	30·1
Rye	6·55	7·22	10·3
Barley	6·13	6·72	9·6
Rice	14·50	26·69	84·1

Whilst the other cereals require 20·25 per cent. of the value of the crop in labour, rice cultivation demands from 23 to 35 per cent.

Valuing wheat at just over 12*s.* per cwt. and paddy at 8*s.* 10½*d.* per cwt.

the value of the crops per acre excluding the milling is as follows:

	Value of yield.	Cost of Labour.
	£. s. d.	£. s. d.
Wheat 8·23 cwt. per acre ...	4 19 5	(¼) 1 4 10
Rice 26·69 ,, ,, ...	11 16 7	(¼) 2 14 2

These figures give some idea of the benefit to the cultivator from rice cultivation.

The effect of rice cultivation on the health of the inhabitants is shown by the greater diminution in the death rate from malaria in the districts between the Po and the Ticino in proportion to the increase in this cultivation. The diminution in the death rate per thousand from the period 1875-1888 to 1902-1912 is shown by the following figures.

Districts.	1875-1888	1902-1912
Novara	28·68	18·6
Vercelli	29·11	16·5
Pavia	24·09	19·6
Mortara	27·75	15·2

The writer compares these figures with those relating to the districts of the same region where rice is not cultivated and shows that the diminution in the mortality during the same period is about the same as in the rice districts, though the former districts (e.g. the mountains of Sondrio) are considered to be very healthy.

Although rice cultivation is said to favour malaria and occasionally fatal cases have been recorded, the disease is much less serious and less prevalent in rice-growing districts than in other districts.

This is shown by the figures in the table below which compares the number of deaths caused by malaria in Italy during the period 1896-1898, when the method of prevention of the disease was unknown, with the death rate in the period 1910-1912 when preventive measures were adopted everywhere.

Thus, of the total deaths caused by malaria during the triennial period 1910-1912, 5·5 per cent. were in northern Italy and the remaining 94·5 per cent. in the rest of the country.

Comparison of the Numbers of Deaths due to Malaria in Italy in 1896-1898 and 1910-1912.

	Triennial period.		
	1896-1898	1910-1912	Percentage.
Northern Italy:			
Piedmont	581	38	6.5
Liguria	65	12	9·6
Lombardy	822	96	11·6
Venetia	1,099	366	33·2
Emelia	607	101	16·6
Rest of Italy	42,601	10,595	24·8
Entire country	45,775	11,208	24·6

Further, the decrease was greatest in Piedmont, the greatest rice growing district. There is therefore no truth in the statement that rice fields and malaria are inseparable.

The question of the effect of rice fields on the physique of the inhabitants is shown by the proportion of discharges from the army. During the quinquennial period 1886-1890 the percentage of discharged soldiers in the rice growing districts was equal to or a little less than those of the neighbouring provinces, whilst the percentages in the regions of southern Italy, where rice fields are almost unknown and where the malaria is of much more serious type, were much higher, almost double and even more in some cases.—BULL. INTERNAT. INST. OF AGRIC.

FOOD PRODUCTS.

LEUCAENA GLAUCA AS A SUBSTITUTE FOR COFFEE.

HARVEY C. BRILL.

The use of *Leucæna glauca* as a substitute for coffee has recently been brought to our attention by the Philippine Bureau of Education. The supervising teacher of Bauang, La Union Province, reports that several of his teachers have used it instead of coffee with pleasant results.

Leucæna glauca (L.) Benth., known as *ipel*, or *ipel-ipel*, among the Tagalogs, is widely distributed throughout the Philippine Islands, although it is not native, having come originally from Tropical America. MERRILL* says of this species :

"A native of tropical America, now widely distributed in tropical and subtropical parts of the world; very abundant and widely distributed in the Philippines at low altitudes, the timber being used for house posts and for firewood. In Leyte the seeds are used by the natives as a substitute for coffee."

Leucæna glauca Benth. has attained considerable prominence of its value as a reforestation crop. About 40 per cent. of the total land area of the Philippine Islands has become covered with grass to the exclusion of practically all other vegetation. Areas such as these are difficult to reforest, and are not cultivated, owing to the frequency of fires and the case with which cogon—the dominant grass occupying these tracts—crowds out the other vegetation. Cogon possesses a dense mass of underground stems, which spreading throughout the upper layer of the soil deprive it of nearly all the available moisture during the dry season. The removal of the grass for the purpose of reforestation is impracticable, because of the cost, and few trees are able successfully to compete with the cogon. Ipel, however, can thrive under these conditions, and owing to its habit of growing in thickets, soon chokes out the grass. Other trees can be successfully grown among the ipel. Indeed the presence of ipel is an advantage, since it serves as a shade to the young tree and raises the height at which the tree sends out branches.

While the ipel is not so valuable a firewood as the *bacauans* (the mangrove trees) yet, in the growing scarcity of these and the demand for a quick-growing firewood for sugar centrals, etc., its value here will eventually increase.

Another factor worth considering is the improvement of the soil brought about by the cultivation of ipel. Since it belongs to the legumes, it possesses the property common to the members of this family of fixing the nitrogen of the air and making it available for plant growth. The shrub, or small tree, grows to a height of from 2 to 6 metres, in rare cases 10 metres, and bears thin, flat pods, from 12 to 18 centimetres long, within which are from fifteen to twenty-five small, shining, flattened, brown seeds about 8 by 4 by 1·5 millimetres in dimensions.

PHIL. JOURN. OF SCIENCE, Sec. C. (1910), 5, 30.

These seeds when roasted and ground produce a reddish brown powder, having a colour very similar to that of coffee and with an odour somewhat resembling the aroma of coffee. The odour of the infusion with water resembles the odour of coffee more closely than does that of the ground, roasted bean.—PHIL. JOURN. OF SCIENCE, SEC. A.

THE PINK DISEASE OF CACAO.

J. B. RORER.

At rare intervals during the past seven years specimens of the pink disease of cacao have been found on several estates in the northern and eastern parts of Trinidad. The disease receives its name from the fact that the attacked branches, especially on the lower or shaded side, are covered with a pink incrustation, the fruiting stage of the fungus. This fungus has not proved a serious pest to cacao here, but in the East, on rubber, coffee and tea, considerable losses have been caused by what is now known to be the same fungus, so that any undue spread of it here should be quickly checked

The pink disease has been known in the West Indies for a long time. The first specimens were found in Dominica by STOCKDALE and referred to in a paper dealing with the fungous diseases of cacao, read at the West Indian Agricultural Conference held at Barbados, January, 1908, but the disease was not considered to be of a very serious character. Early in 1909, however, several plots of cacao in St. Lucia were found to be quite badly affected by the same disease. The causative fungus was considered to be *Corticium lilacino-fuscum* Berk. and Curt, evidently having been identified at Kew.

Since these first records of pink disease in the West Indies, reference to it has been made in several books and papers dealing with the fungous diseases of cacao; it has generally been considered that the fungus itself does only little damage, but that the wounds caused by it form places of entrance for other fungi, notably the canker and die-back fungi.

More recently, SOUTH refers to the disease in the West Indies. He states that the causative fungus was identified at Kew as *Corticium lilacino-fuscum* and that in St. Lucia it was found on pigeon peas as well as on cacao. He also states that the fungus resembles the allied species found on cacao in the East, and that there is the possibility of the two being identical, though the local fungus is of far less economic importance, and is apparently much more restricted in its range of host plants.

FAWCETT reports a new fungous disease of cacao in Porto Rico which from the description is the same as the pink disease of Trinidad. It is said to be extremely parasitic and to occur also on grape fruit and coffee. Specimens were sent to the New York Botanical Gardens, but as no spores were present, a specific identification could not be made; the vegetative characters were, however, quite different from those of *Corticium lilacino-fuscum*.

During the past few years the pink disease has attracted considerable attention in the East since it has developed to be a serious pest on some Para rubber (Hevea) plantations in the Malay States, and on coffee estates in Java and other places.

BROOKS and SHARPLES, who have recently studied the disease in the Malay States, give an excellent review of the Eastern literature, so the

reference need not be repeated in this paper. They conclude* that the causative fungus should be known as *Corticium salmonicolor* Berk. and Br. and agree with RANT that *Necator decretus* Massee is only a form of the same fungus. They point out that in many districts of the Malay States it is the disease that requires the greatest amount of attention. In some estates from 10 to 25 per cent. of the trees are attacked. In the East the fungus has been found on no less than 141 different species of plants including hibiscus, camphor, lime, durian, mango and jak-fruit, and causes serious diseases of coffee, rubber, tea and cinchona.

SYMPTOMS.

The disease as it occurs on cacao is very characteristic, and cannot be mistaken. Branches from ½ to 1½ inches in diameter are most frequently attacked. The fungus gains entrances usually near the base of the branch, and then spreads with remarkable rapidity both up and down the stem. Small branches which are met with are quickly killed, and if the fungus reaches the forks of larger branches the whole crown may become affected. The leaves in affected branches wither, turn brown and fall to the ground. At about the time that the leaves show the first signs of something being wrong very fine silken threads can be seen traversing the bark, and small whitish pustules are noticeable, especially at the lenticels. Eventually, as the leaves begin to turn brown, and drop, the affected branches, especially in the lower or shaded side, become covered with light pink incrustation, which becomes slightly darker as it increases in thickness. This is the fruiting part of the fungus, and so far as the writer's observations go, is fairly rich in spores, though it is reported as being frequently sterile in Porto Rico and the Federated Malay States. Up to the present, the Necator stage has never been found in the West Indies. The fungus is extremely parasitic and spreads with great rapidity in wet weather but is immediately checked by a few dry days.

Recently, a beautiful specimen of the fungus on Amherstia has been sent to the laboratory by MISS MINERVA HART, who reports that it is doing considerable damage to the tree, which adds another host to the West Indian list.

REMEDIAL MEASURES.

The treatment of the disease on cacao estates is very simple. Where it only occurs sporadically, the diseased branches should be cut out and immediately burned. If the diseased portions have to be carried out of the fields, they should be put in a bag to prevent the spores blowing about. If the disease should ever assume serious proportions, spraying with Bordeaux mixture or other fungicides would have to be resorted to. This is a comparatively simple matter on cacao estates, or even young (2 to 3 years old) Para rubber estates.

Where the disease has been found to be serious in old rubber estates, spraying is not recommended on account of the almost insurmountable difficulties in the way of spraying tall trees under estate conditions. The disease is best dealt with by cutting out and burning the affected parts where possible, or where only a small number of trees are attacked. Where larger number of trees are affected, good results have been obtained by treating the affected parts with tar, when the first signs of trouble are visible. Two applications, where necessary, at monthly intervals have given good results in the Federated Malay States.

The disease in Trinidad has so far never been found on rubber trees, but now that Para rubber (Hevea) is being planted up to a certain extent, and in some places, among cacao trees, a sharp look-out should be kept for the disease in the surrounding cacao, and every effort made to keep it from spreading to the rubber.—BULL. DEPT. OF AGRIC., TRINIDAD AND TOBAGO.

[* This discovery was made in Ceylon, and was published in 1911.—Ed. T.A.]

TOBACCO.

SOME PROPERTIES OF THE VIRUS OF THE MOSAIC DISEASE OF TOBACCO.

H. A. ALLARD.

Several theories have been advanced to explain the physiological origin of the mosaic disease of tobacco *(Nicotiana tabacum)*. Independently, Woods and Heintzel came to the conclusion that oxidizing enzymes are responsible for the disease. Hunger did not accept the enzymic theory of the mosaic disease but considered that unfavourable conditions of growth produced specific toxins within the plant which led to the appearance of the disease. The writer has secured data which do not lend support to the physiological origin of the disease, but indicate that it is dependent upon specific infection.

Further studies of the properties of the expressed sap of mosaic plants, termed the "Virus" of the disease, have thrown considerable light on the nature of the infective principle and its relation to some of the enzymic properties of the sap of diseased plants.

Woods and other workers following him have attributed the origin of the mosaic disease to oxidases and peroxidases existing normally in healthy tobacco plants. Since it is a question of fundamental importance to determine whether or not such enzymes are the primary cause of the disease, their relation to infection has been more fully investigated. All data at hand indicate that infection does not depend upon the presence of oxidases or peroxidases, but upon an infective principle which is not a normal constituent of the sap of healthy plants. These conclusions rest upon the fact that methods have been found by which the infective principle may be separated from the oxidases and peroxidases present in the sap of mosaic plants as shown in the experimental work.

SUMMARY.

In this paper are given the results of a study of the properties of the virus of the mosaic disease of tobacco, and evidence is adduced to show that the infective principle cannot be identified with peroxidase. Briefly, the facts obtained may be stated as follows:

(1) The infective principle of the mosaic disease of tobacco is retained by the Livingstone atmometer porous cup used as a filter, and also by powdered talc. Although the filtrates may show intense peroxidase reactions, they no longer produce infection.

(2) The infective principle of the disease is quickly destroyed in alcohol of a strength of 75 to 80 per cent. In this strength precipitation of the peroxidase is complete. By filtering the solution the peroxidase may be collected, freed from alcohol by evaporation, and redissolved with water. This solution gives intense peroxidase reactions, but no longer produces infection. Alcoholic solutions of virus of 45 and 50 per cent. strengths did not destroy

the infective principle of the disease within the same period. In these solutions the pathogenic agents are not destroyed and appear to be carried down with the precipitate, leaving the supernatant solution without infectious properties, although giving strong peroxidase reactions.

(3) By the addition of different quantities of hydrogen peroxid to the virus, it is possible to find a concentration of sufficient strength to destroy the peroxidase, but leaving little or no free peroxid in the solution. Such solutions no longer show peroxidase reactions, but retain their infectious properties for a long time. A considerable excess of hydrogen peroxid destroys the infective principle itself. The quantity of peroxid required to destroy the peroxidase without leaving any considerable excess in the solution depends upon the nature of the virus, the amount of active catalase present, etc.

(4) The virus was treated with formaldehyde for 31 days in the following concentrations: one part formaldehyde in 100, 200, 400, 600, 800, 1,000, 1,200 and 1,500 parts of virus solution. The solutions containing 1 part formaldehyde in 800, 1,000, 1,200 and 1,500 parts of solution gave infection Stronger concentrations were no longer infectious, although giving intense reactions for peroxidase.

(5) Ether, chloroform, carbon tetrachlorid, toluene, and acetone failed to extract either the infective principle or the peroxidase from dried mosaic material. These solvents also failed to destroy the infectious principle in this material. Ethyl and methyl alcohol completely destroyed the infective principle in the leaf material itself, as well as in the extract. No evidence of peroxidase was obtained in the alcohol extracts. Glycerin does not destroy the infective principle of the disease. Water extracts of dried material not only show peroxidase reactions, but also contain the infective principle of the disease.

(6) A precipitate of aluminium hydroxid, formed by adding aluminium sulphate to alkaline solutions of virus, appeared to carry down the infective principle of the disease, leaving the clear, supernatant solution without infectious properties, although showing good peroxidase reactions. Similar treatment with nickel sulphate was not so satisfactory, as it gave evidence of being more toxic to the infective principle than the aluminium salt.

(7) The virus is quickly killed at temperatures near the boiling point of water. In some instances heating the virus for five minutes at 80°C. was sufficient to destroy its infectivity. In other tests, with a different virus solution, heating for five minutes at 90° did not entirely destroy its infectivity. In dried and ground mosaic material, rendered water-free by drying over sulphuric acid in a desiccator, the infective principle resisted much higher temperatures than it did in solutions. If virus solutions are heated, the thermal death point of the infective principle is lower than that of the peroxidase; or at least it is more quickly destroyed than the peroxidase.

(8) The virus is highly resistant to low temperatures. When frozen to a temperature of—180°C. with liquid air, its infectious properties were not weakened.

(9) Unpreserved solutions of virus have sometimes lost their peroxidase activities without losing their infectious properties. Dried and ground mosaic material has also lost its peroxidase activities and still remained highly infectious. Talc-treated material, while retaining its infectious properties, has lost its peroxidase activities.

(10) Solutions of virus sometimes lose their infectious properties and continue to show intense peroxidase reactions, as when allowed to evaporate spontaneously in one instance. The fæces of worms fed upon mosaic plants have, in some instances, failed to produce infection, although such material continued to give intense peroxidase reactions.

(11) The writer's experiments show that peroxidase or catalase in the sap of mosaic plants cannot be responsible for the mosaic disease. The same enzyms are normally present in healthy plants, but the sap of such plants is without infectious properties. By evaporation the enzyms present in healthy sap may be brought to a high concentration, and such solutions never acquire infectious properties. By dilution, on the other hand, the peroxidase content of mosaic sap may be diminished to such an extent that peroxidase reactions are no longer discernible; yet such solutions may remain highly infectious.

Since it has been shown that the mosaic disease of tobacco does not occur in the absence of infection, neither enzyms nor other normal constituents in the sap of the healthy plants can be considered responsible for the disease. A specific, particulate substance not a normal constituent of healthy plants is the cause of the disease. Since this pathogenic agent is highly infectious and is capable of increasing indefinitely within susceptible plants, there is every reason to believe that it is an ultramicroscopic parasite of some kind.—JOUR. OF AGRIC. RESEARCH.

CLUB ROOT (*PLASMODIOPHORA BRASSICAE*) IN NEW ZEALAND.

A. R. COCKAYNE.

During 1915 club-root has been extremely prevalent in various parts of New Zealand.

Club-root attacks only plants belonging to the turnip family (*Cruciferæ*) and in New Zealand has been reported as occurring on the following cultivated members of the group: cabbage, cauliflower, Brussels sprouts, rape, mustard, swede, turnip, soft turnip, radish, and wall-flower. The disease is also found on the roots of certain weeds belonging to the same family amongst which may be especially mentioned: Shepherd's purse (*Capsella bursa-pastoris*), wild turnip (*Brassica campestris*,) American cress (*Barbarea præcox*), hedge-mustard (*Sisymbrium officinale*) and pepper-wort (*Lepidium ruderale*).

Club-root is widely distributed, and has been found in all classes of soil in New Zealand. It is, however, most prevalent on the west coast of the North Island, and especially in the Taranaki and North Wellington districts. In the South Island it is comparatively rare as a field crop disease, but is often abundant in garden soils. Those districts in which the underlying rock is largely composed of limestone generally are comparatively free from the disease, but at certain times bad outbreaks occur in such localities. In such cases it is probable that although the subsoil is largely of a calcareous nature the upper layers are deficient in lime, owing to it having been leached out in the ordinary processes of weathering. Acid soil conditions are far more favourable for the development of club-root than are those of neutral or alkaline soils. A very noticeable feature with regard to club-root is the fact that its prevalence as a serious disease did not take place in Europe until the modern use of fertilizers of an acid nature. The following are the most advisable means of control:—

(1) Abundant dressings of calcium carbonate (ground limestone) in the case of badly affected land, as much as 7 tons per acre, to be done in the autumn previous to the sowing of the seed.

(2) Leguminous crops should be grown on affected land.

(3) Preference should be given to the swede varieties which are more resistant, that is: Superlative, Magnum Bonum, John Bull, Elephant and Crimson King.—BULL. INTERNAT. INST. OF AGRIC.

FRUIT.

THE EFFECT OF VARIOUS DRESSINGS ON PRUNING WOUNDS OF FRUIT TREES.

G. H. HOWE.

An account of experiments, begun in 1911, with different substances on pruning wounds of fruit trees, in order to determine the effect of the various compounds in accelerating the cure of the injury and their preservative action against the attacks of fungi and injurious insects. These experiments have been made on apple trees (as representative of the pome fruits) and on peaches (as representative of stone fruits).

The following substances were employed: white lead, white zinc (both mixed with linseed oil), yellow ochre, coal tar, shellac and Avenarius carbolineum. They were applied, at different times of the year, to pruning wounds of various sizes, some newly inflicted and others of some weeks' standing. The effects were observed, both in the case of the treated wounds and in that of those which were left open, at the end of the first and the second season of growth. The principal results were as follows:

In all cases the untreated wounds healed more rapidly than those protected by any of the substances enumerated. Amongst the latter, shellac seemed, during the first period of growth, to exercise a stimulating effect on the development of bark around the wound; this effect, however, ceased at the second period of growth. Shellac caused the least injury to the tissues of the cambium, but, on the other hand, it had the least adhesive power. Avenarius carbolineum and yellow ochre did so much harm to the cambium that, in the writer's opinion, they should never be used for covering pruning injuries. The lesion produced by coal tar was less serious, but this substance disappeared more quickly owing to absorption and evaporation. White lead and white zinc also produce a slight injury to the cambium tissues when they are first applied, but these tissues soon recover, and at the end of the first growth period hardly any trace of injury is left. White lead and white zinc were the most efficacious of all the compounds used, and the former was the better of the two.

Nothing is gained by waiting some weeks after pruning before applying the dressings.

All the substances used in the experiments in treating the pruning injuries of peach trees produce such damage to the wood, that the wounds did not close. Consequently these substances should never be applied to the wounds of the peach; this probably applies to all other trees with stone fruit.

In no case were the wounds, whether open or protected, observed to be invaded by fungi. As the substances used seemed rather to retard the healing of the wounds, it may be concluded that the treatment of injuries to the wood is, to say the least, useless. Nevertheless, had the experiments been carried further, it is possible that they might have exercised a useful effect upon the healing of very large injuries; this however still remains to be proved.—BULL. INTERNAT. INST. OF AGRIC.

SPRAYING FOR RIPE-ROT OF THE PLANTAIN FRUIT.

JEHANGIR FARDUNJI DASTUR.

The plantain fruit is often affected by a ripe-rot caused by a fungus *Glœosporium musarum*, chiefly during the rains. This disease is common wherever plantains are grown. It is confined to the fruits and the fruit stalk.

In India, as far as the writer is aware, it is chiefly a disease of the stored fruits ; but it is also found on very young fruits though, fortunately, not often. The presence of the fungus on mature fruits is marked by the appearance of a small black circular speck on the peel. This rapidly increases in size, becomes depressed and in this sunken area are found pink concentric rings which look moist and bright when fresh on account of the presence of oil globules. These concentric rings are the spore beds ("acervuli") of the fungus. There are generally more than one such diseased areas which merge into one another and eventually cover the whole fruit. The effect of the disease is to ripen the fruit prematurely and this in its turn accelerates the rot. When the young "fingers" get infected, the infection is generally found to begin from the distal end, possibly arising through the flowers. The infected "finger" begins to turn black and shrivel from the distal end ; as the infection progresses the whole "finger" turns black, shrivels, and becomes covered with the pink spore beds of the fungus. The attack rapidly spreads and involves the whole bunch. The fruit stalk also gets diseased but the infection does not spread to the "hands" through the stalk.

This disease is of annual occurrence during the rains. In the absence of the perfect stage of the causal fungus (the perithecial stage containing the ascospores, or winter spores, which has not yet been found, though this disease has been investigated by so many workers), the question naturally arises how does the fungus ensure its annual occurrence. It has been found in nature to produce only one kind of spores and they are thin-walled individually not capable of resisting unfavourable conditions. If the spores are sown in a drop of water they readily germinate in a short time, but if the drop of water in which they are sown is allowed to run dry and after a short time the spores are resown in water, they are found to be dead. On the other hand, if the spores *en masse* are allowed to remain in their acervuli they have been found to germinate after nine months. The acervuli, which, when fresh are moist and bright pink in colour, become dry and dull light pink after some time ; they are then found to be covered by a dry crust which keeps the enclosed spores in a compact mass and protects them from unfavorable conditions. When a drop of water is added to this spore mass it breaks away, setting loose the spores which are capable of germination. Diseased parts of the fruit stalk and diseased fruits were kept along with dried plantain leaves in an open basket on the working bench in the laboratory in September. Spores from the diseased parts thus preserved were sown in water in June, nine months later. The spores germinated, though of course the percentage of germination was not very high. It is probable that in nature also the spores remain thus preserved on the plantation and during the rains the spore masses break up, the spores get disseminated and infect healthy fruits.

This fungus has been found to be a wound parasite, i.e., it attacks the host only through wounds or abrasions on the surface.

Since 1912 this disease has been under study with the object of finding some remedial measures for its prevention. Freshly picked mature green fruits have been dipped in different strengths of copper sulphate, formalin and corrosive sublimate for varying lengths of time without any success. In passing it may be noted that unripe fruits treated with formalin ripened earlier than those of the same bunch treated with other fungicides or the untreated ones kept as controls. Spraying the fruit about two months old once every fortnight till mature with Burgundy mixture or Ammoniacal copper carbonate also failed.

It was found that treating the fruits when picked or when half-grown was useless. Fruits picked from bunches which were only half-grown and looked outwardly quite healthy, and which were sterilized by washing them in corrosive sublimate for five minutes gave *Glœosporium* pustules on incubating them under aseptic conditions. The pulp removed aseptically from green and unripe fruits remained sterile on incubation but the peel from the same fruit, sterilized by dipping it in rectified spirit for a minute and then flamming off the spirit, occasionally gave *Glœosporium* pustules when incubated in sterilized moist chambers. These results show that the fruit can be attacked long before it gets ripe and before the disease becomes outwardly visible, but the fungus remains dormant in the peel till suitable conditions arise for developing its activities. SHEAR and MRS. WOOD, who also have found dormant infections of *Glœosporium* and *Colletotrichum* present in many instances in leaves and fruits showing no external signs of the disease, give a very probable explanation. The conidia germinate whenever they come in contact with the plant surface under favourable conditions and produce appressoria; these are thick-walled bodies which are capable of enduring more unfavourable conditions than the thin-walled conidia or spores. These appressoria send germ-tubes through the epidermis, in the case of the banana fruits possibly through the wounded surface, as the fungus has been found to be a wound parasite only. The germ-tube apparently penetrates at first but a very short distance, does little harm to the host cell and remains in an inactive condition till favourable conditions for its further development, such as the weakening of the vitality of the fruit or excessive humidity, arise.

As it soon became evident that the fungus infects the fruit even when green, and that, consequently, spraying the fruits long after they had set was useless, and as the disease is most prevalent during the rains, the spraying was done as soon as the "fingers" opened in June, before the rains set in.

On account of the difficulty of procuring pure unslaked lime during the rains, the well-known fungicide, Bordeaux mixture, was not tried, since the application of a badly prepared mixture does more damage to the plant than not applying it at all. In place of Bordeaux mixture, Burgundy mixture (in which lime is replaced by washing soda) was used. Another fungicide that was tried was Ammoniacal copper carbonate. Though this latter checked the disease, still its continued application was found injurious to the fruits. They were sprayed once every fortnight and after the fourth application the spray marks became very prominent. The spray remained lodged where the "fingers" rubbed against each other and here the peel took a sooty brown colour. In cross sections the epidermis and a few layers of the cell underneath it were found to have turned brown, the pulp remaining unaffected. The fruits ripened normally and did not get diseased; but fruits having these spray marks would be unfit for the market. A solution of half the strength used in the previous case failed to check the disease though it did not injure the fruits. As the other fungicide, Burgundy mixture, gave successful results no further experiments were made with different strengths of Ammoniacal copper carbonate. Fruit bunches which had just opened all their "hands"

or had partly opened them before the rains set in were selected for spraying. This was done once every month till the fruits were ready for picking, except in the case of bunches which were partly opened at the time of the first spraying when the second spraying was done after a fortnight by which time the "hands" were fully opened. In all at the most four applications were given before the fruit bunches were picked. As Burgundy mixture leaves bluish specks on recently sprayed fruits, they would be unpresentable in the Indian market in this state; so when the last spraying was to be done within a fortnight of the picking of the fruits this mixture was replaced by Ammoniacal copper carbonate which keeps the fruits clean. When the fruits were picked they were dipped in Ammoniacal copper carbonate in order to remove completely the Burgundy mixture marks; these marks may also be removed by gently rubbing them with a brush or cloth soaked in Ammoniacal copper carbonate.

Spraying on these lines has been done for the last three years during the rainy season on a very restricted scale, but still the results obtained have been very definite and hopeful. The sprayed fruits developed very little *Glæosporium*, and even this little attack was generally found when the fruit had become over-ripe. As a rule the attack was observed to begin from the distal end of the fruit, from the dried remains of the style. Unsprayed fruits kept as controls got diseased, the whole bunch being destroyed, while over-ripe fruits of sprayed bunches showed only a few *Glæosporium* pustules.

It may be here noted that neither Burgundy mixture nor Ammoniacal copper carbonate have been found to check the scab disease of the fruit.

Along with spraying other precautions are necessary for checking the *Glæosporium* disease. When all the "hands" have opened, the fruit stalk should be cut as far back as the last hand, in order not to have any dead part of the fruit stalk where the fungus may live saprophytically. Fruits when picked must be handled very carefully in order not to injure the peel and thereby not to open a way for the fungus to enter by. Mummied fruit and fruit stalks must be removed and disposed of at a distance from the plantation or preferably burnt. The room where fruits are stored should be occasionally disinfected or whitewashed.

Acknowledgments are due to Babu P. C. KAR, Fieldman to the Imperial Mycologist, for doing the spraying work during the writer's absence from Pusa last monsoon.

PREPARATION OF BURGUNDY MIXTURE.

This mixture is made in the following proportions :—

2	lb.	copper sulphate.
$2\frac{1}{2}$	,,	washing soda (carbonate of soda).
10		gallons of water.

Dissolve 2 lb. of copper sulphate in 5 gallons of water. In order to do this suspend the crystals in a piece of gunny bag near the top of the water in a barrel. It will dissolve in a few hours, but if the crystals have been previously ground they will dissolve more quickly.

Dissolve $2\frac{1}{2}$ lb. of washing soda in 5 gallons of water in a separate vessel. Then pour the washing soda solution slowly into copper sulphate solution in the barrel stirring continuously. The mixture should then be ready for use; before using this mixture it should be ascertained that it is not acid in reaction. If blue litmus paper turns red on dipping it in the solution, add to the mixture in small quantity more washing soda dissolved in water till a fresh piece of paper dipped in the mixture remains blue.

The solutions of copper sulphate and washing soda kept in separate vessels will keep good for several days, but once the solutions are mixed, the mixture should be immediately applied, as it deteriorates very rapidly.

Vessels coming in contact with copper sulphate should not be of metal.

PREPARATION OF AMMONIACAL COPPER CARBONATE.

This solution is made in the following proportions:—

Copper carbonate	... ...	5 oz.
Strong Ammonia water (B.P.)	...	3 pints.
Water	...	50 gallons.

Make the copper carbonate into a paste with a little more than one pint of water. Then add the ammonia slowly and stir till all dissolves, except about ¼ oz. or so. If all dissolves add more copper carbonate so as to have an excess. This gives a deep blue clear solution. This can be kept as a stock solution in a well-stoppered bottle. Dilute this stock solution to 50 gallons with water before use.—AGRIC. JOUR OF INDIA.

TEA CULTIVATION IN AFRICA.

Apparently we have not yet seen the last of the prospective experiments with tea, says a writer in the Calcutta CAPITAL. The dark continent seems keenly anxious to obtain some share in the production of the valuable commodity that has hitherto been believed to be the exclusive product of the East. Already there are records of some progress in this line from four different centres, viz., Natal, Nyassaland, Southern Nigeria, and Uganda. Of these, the first named country is the only place where tea cultivation has been undertaken on a serious scale.

There is often a serious disadvantage in the conduct of large industrial concerns like those of tea in India and Ceylon. Those actually engaged in the work from year in and year out, with all its complex problems and various demands upon the attention, necessarily get but few opportunities to study the whole question from a general aspect or an outside point of view. This, however, not seldom involves issues that vitally affect the industry as a whole. The principles that regulate modern commerce are quite incompatible with a closed-door policy. There, no doubt, still survive a few monopolies that occasionally lie in our way, but they must be regarded as the remnants of a more primeval period when individual interests succeeded in supervening over the exigencies of the general weal of communities. It is therefore of the utmost importance to keep ourselves well posted up with all the movements of the great world beyond our immediate view so as to be best able to ensure success on our own lines.

NATAL'S YEARLY OUTPUT TWO MILLION POUNDS.

Africa, as a whole, with its dry and high tablelands, is quite unsuitable for the cultivation of tea, but there is very often a coastal line, more humid and warm, ranging from an altitude of 800 to 1,000 feet, where its cultivation has been attended with much success. As already mentioned, Natal stands the first in order of precedence. Here the cultivation, both in experimental and commercial stages, has proved successful, and has managed to establish an industry of more than a mere local magnitude. The first venture was made about thirty-eight years ago, when some tea seeds, obtained from Calcutta, were planted as soon as they arrived. The varieties introduced were the "Assam Indigenous" and the "Assam Hybrid" that were supplied, the first from Rookang estate and the second from Longeburr estate. But the first few years were mere records of failure caused chiefly by climatic accidents and insect pests. It was, therefore, not until four years later, in 1881, that any real attempts were made to introduce the cultivation of tea in Natal on a plantation system. Within the next year or two the results proved much more encouraging, and in 1883 nearly 149 acres were placed under this cultivation. Once the initial difficulties had been overcome, the course of further progress was almost unchecked, and in ten years more (1893) the total acreage under tea in this colony rose to 1,883 acres, and by the next decade it averaged between 3,000 to 4,000 acres, yielding an approximate annual out-turn of 2,000,000 pounds of the manufactured article.

—TEA AND COFFEE TRADE JOURNAL.

SUGAR-CANE.

THE IRRIGATION OF SUGAR-CANE IN MAURITIUS.

The British Island of Mauritius has been an active sugar producer for many years. Its crop production in 1890 reached 126,000 long tons; in 1895 it was 143,000; in 1900 it reached 183,000; in 1905 it was 186,000 and in 1910 it had gone up to 223,000 long tons. Its maximum crop seems to have been 253,000 tons in 1909.

The desire expressed by the British Government for an increased production of sugar in its various Colonies has led to some careful experimentation as to the value of irrigation to the crop in Mauritius. Our readers will recall the fact that when Dr. Walter Maxwell went out to Australia from the Hawaiian Islands he immediately called the attention of the Queensland sugar producers to the great advantage that might lie to them in an adequate supply of irrigation water, such as had for years been successfully demonstrated in the Hawaiian Islands. More or less of this irrigation work was done under the influence and the teachings of Dr. Maxwell, but irrigation at no time became a necessary feature and we have not heard much of it since Dr. Maxwell's withdrawal from Australia.

Our data lead us to believe that they have a comparatively satisfactory rainfall in Mauritius, but yet at times suffer severely by drought. In Cuba it has often been thought that irrigation would be extremely beneficial at times, but it has been found also that large areas of land there at times become flooded by excessive rains, and great injury to the cane crops there has resulted. There can be no doubt but that with high temperature, bright sunshine and adequate moisture in the soil the very highest degree of effectiveness in plant growth is brought about, but we may have severe and damaging droughts, and especially in semi-arid locations, such as are prevalent in Hawaii and also in some parts of Australia.

It is only now that the Mauritius Government has awakened to the importance of this feature of the sugar industry and has made some experiments that are strikingly convincing, coming as they do directly from the report of Hon. F. A. Stockdale, the Director of Agriculture. Canes planted in December, 1913, gave a yield of 31·39 tons of cane per arpent without irrigation. The old French measure of arpent is a lineal measure and when used as a measure of area the French arpent equals about five-sixths of the area of an English acre. These experimental canes were cut in September, 1915, and the average yield of the irrigated plots are as follows: eight plots watered once weekly gave 46·14 tons per arpent and four plots watered twice weekly gave 49·33 tons per arpent. Notwithstanding these extraordinary advantages gained by irrigation, the record of rainfall showed that during the twenty-one months from the time this cane was planted until it was harvested the rainfall reached 79·32 inches.

The underlying element of success in the irrigation of sugar cane would seem to be that with the power thus secured plant growth would not be retarded by a deficiency in moisture. Here in Louisiana we have often found that during our hottest sunshiny weather our cane growth at times has been inconsiderable because of the lack of moisture. Of course with a rainfall the atmosphere becomes more or less cloudy and one of the factors of growth is

diminished in its effectiveness in that way. With irrigation each of the essential features of plant growth, sunshine and humidity, is placed under control by artificial irrigation.

The Peruvians have given great attention to irrigation and the Hawaiians at the cost of millions of dollars have reduced it to a science so far as their climate and soils are concerned. Irrigation of cane fields in Louisiana wherever practised has generally been abandoned, largely, we think, from a lack of precise knowledge of the results, but in fact, because of our generally ample rainfall and reasonably fair distribution of that rainfall throughout the growing season. We have a saying among the cane planters that a good August is an August in which rain falls every day, and August in Louisiana is the month of the most active growth of sugar cane.

Director Stockdale in his statements of the soils of Mauritius divides them into red and black soils, the red being the best adapted to the cultivation of sugar cane and the black soils there, as here, being thought better adapted to the cultivation of Indian corn. Doubtless the black soils there as here are generally of clay formation and are not expensive, but difficult to cultivate and as long as the lighter soils, containing more sand are available, they will always have the preference.

Director Stockdale states it as a general conclusion that the irregularity of the rainfall in the Colony is the cause of the shortage of the cane crop and that on this account it is hoped that the output of the Colony would be made more regular by the contemplated irrigation.

Director Stockdale refers to another point in connection with irrigation and that is the statement that irrigation water never gives the same results, unit for unit, as does rain water. The recent researches at Rothamsted Experiment Station in England are to the effect that rain water in falling through the air takes up a quantity of oxygen and thus a fall of rain on the soil not only increases the water content of the soil, but also the oxygen content. This varies a little from the older theory, which was that the rainfall brought down also the ammonia from the air and carried it into the soil. The Rothamsted conclusion is that a fall of rain not only waters the soil, but also aërates it and in Mauritius irrigation water does not always do this. Mr. Stockdale brings out definitely the idea that in intensive culture it is equally important to ventilate the soil as it is to manure it.

In writing of the possibilities of irrigation it is stated that the maximum quantity of water well distributed required for cane cultivation per annum in Mauritius is 75 inches. The maximum for any month is 8 inches and the maximum number of waterings per month is three. The quantity of water required for a single watering is 2·6 inches.

As the contour of the Mauritius lands is irregular, careful irrigation necessitates careful laying out of the land, so that the water will reach all of the cane rows without giving any part excess, and at the same time insuring all the rows having a proper quantity.

The whole subject matter is extremely interesting and just as all culture is an attempt to improve upon nature, just so it seems a pity in seasons generally adapted to the growth of sugar cane that there should be an almost complete suspension of the growth because of a lack of moisture when we live in a land where water is available. In Louisiana when the water has been used we have found at times the results less satisfactory than were expected. We seemed to have much to learn yet to secure satisfactory irrigation of sugar cane in this western world, our most advanced people in that respect being the Peruvians and the Mexicans, where they have no alternative but to irrigate. In Hawaii on the rainy side of the mountains, where they say they do not need much irrigation because of their ordinary rainfall, the plantations have been less profitable than those where they depend entirely upon irrigation.—

Louisiana Planter and Sugar Manufacturer.

SOILS AND MANURES.

EFFECT OF GREEN MANURES ON THE GERMINATION OF VARIOUS SEEDS.

E. B. FRED.

When green manures are turned under and the soil planted immediately a decrease in germination may result. This problem was considered of sufficient importance to warrant a series of field and laboratory experiments in an endeavour to find some explanation for this phenomenon. The causes that might be offered to account for the harmful influence of green manures on seed germination are:

(1) that the green manure not only causes a marked increase in number of bacteria but also a change in the flora;

(2) that the great increase in number of bacteria results in a possible accumulation of some substance or substances, toxic to germination;

(3) that the rapid multiplication of micro-organisms greatly increases their metabolism.

In order to gain some idea of the practical importance of this problem a series of field tests was conducted. The results of this work show that when green clover or oat tissue is turned under and the land planted immediately, there is a distinct decrease in the rate of germination with cotton, soy bean and hemp seed. The cereals, corn and oats, fail to show any injury from green manures. After twenty-five days the injurious factor seems to have disappeared entirely. Under greenhouse conditions it has been found that small amounts=0·25 per cent. of green manures are injurious to the germination of cotton seed. Larger amounts are more evidently injurious. The addition of calcium carbonate to the green manure fails to prevent the injurious action. The degree of retardation seems to vary somewhat with the soil type; in heavy soils green manures have their most marked effect; furthermore an increase in moisture causes a decrease in rate of germination.

When peptone and casein are added in the same nitrogen ratio as the green manure, no decrease in germination is noted. Soluble carbohydrates in amounts of 1 to 2 per cent. retarded the rate of germination, but did not cause the seed to decay as in the case of green manures.

Determinations of carbon dioxide and ammonia in green manure soils were made. Periodic analyses failed to show the presence of these in quantities great enough to account for the injury to seed germination.—Bull. Internat. Inst. of Agric.

POTASH.

Since the war broke out, the world has been searched to try and secure fresh sources of potash, and we have just read that in New Mexico, United States, large deposits have been discovered. We hope so. In the meantime

almost every source of potash has been utilized. Wood-ash is one source—indeed the chief source outside of mineral supplies. We here apply manure to such a small extent to our land that probably our readers have not been very much interested in potash. All sorts and forms of manure here are wasted in the most extravagant manner. For instance, how much of the wood-ashes from the kitchens is saved and applied to the land? We can answer for ourselves that little is wasted where we are concerned, but we are sorry that we cannot so answer for the large majority. At the small cane mills throughout the country tons of wood-ashes—a valuable fertilizer—are wasted every year.

Bananas are peculiarly greedy feeders of potash, and the stems, leaves and stalks are rich in potash. The dry leaves used in millions to wrap the bananas carried to the buying depots, commonly called banana trash, are wasted here in immense quantities although nothing like to the extent of years back when tons were flung into the sea or burned at the various buying centres. Even now we see heaps being burned at railway stations.

Here is an interesting paragraph we take from Chambers' Journal for June—the banana stalks mentioned being of course the fruit stalks after the banana fingers have been taken off, which should not be confused with the banana stems:—

"One result of the war has been the complete cessation of our supply of potash for fertilizing purposes, for the whole of it came from Germany, where, it may be remembered, it constituted a powerful monopoly. Yet this chemical is indispensable for nourishing the soil under these circumstances it is incumbent upon us fully to avail ourselves of every source of supply, no matter how unlikely or unimportant it may at first light appear. One such possible source was described recently by Mr. R. H. Ellis before a Leeds meeting of the Yorkshire section of the Society of Chemical Industry, and the discovery was the direct outcome of a chance observation. Mr. Edward E. Lawson inadvertently left some banana-stalks lying upon the polished seat of his office chair. Upon his return he was somewhat surprised to find that all the French polish had been removed at the places where the stalks had been in contact with the wood, pointing to the presence of some strong alkaline reagent. He communicated his observations to Mr. Ellis, who thereupon investigated the economic possibilities of the discarded stalks although his main line of examination was the suitability of the tough fibre for paper-making. While engaged in this work he noticed that the juice of the stalk, when it came in contact with the human skin, set up a decided irritation. Accordingly he probed the mystery more deeply, ultimately to discover that the stalk contained a high percentage of potash, and practically no soda. This analysis was subsequently confirmed by Dr. A. J. Hanley, of the Agricultural Department of Leeds University. As a matter of fact, it was ascertained that the dried matter of the stalk contained as large a percentage of potash as the German kainit. The investigations showed that a ton of the useless stalks would yield one hundred and eighty-eight pounds of dried matter containing 13·7 per cent. of potash—that is, over twenty-five and a half pounds. The yield may not appear to be very great per ton; but, when the huge consumption of bananas is borne in mind, it should represent in the aggregate a considerable amount. For instance, it is computed that

in Leeds alone the stalks of at least four thousand bunches of bananas are burned as useless every week. These weigh sixteen thousand pounds, and contain one thousand three hundred and forty pounds of dried matter as rich in potash as Kainit. Probably other cities would point to a weekly consumption proportionately great. At present these stalks are regarded as refuse, and are disposed of in dust destructors; but if the whole available yield were scientifically treated, so as to secure the maximum yield of potash, an appreciable contribution would be made to our fertilizing agents.—Journ. Jamaica Agric. Soc.

THE SECRETION BY THE ROOTS OF SUBSTANCES TOXIC TO THE PLANT.

M. MOLLIARD.

With the object of determining whether the roots of higher plants are capable of secreting substances poisonous to themselves the writer made a series of cultures of peas, the roots of which were allowed to develop in distilled water, so as to eliminate the factor of the decrease of the mineral substances present in the solution. In addition, the cultures were strictly aseptic, in order to exclude the intervention of micro-organisms. The seeds were sterilized by being placed for some moments in contact with absolute alcohol and subsequently for two minutes in a 1 % solution of bichloride of mercury. The results obtained were evident from the second crop onwards, the difference between the roots of the peas and those of the controls being distinctly noticeable. The water in which the root system of an initial pea-seedling has grown manifests distinct toxicity to a second seedling, and this occurs in the absence of all micro-organisms. After further experiments to dispose of any doubts that could possibly remain as to the method of sterilisation and of the different conditions of the experiment generally, the writer concludes that the roots of peas secrete substances having a toxic effect upon the organ which produces them, and this occurs without any bacterial intervention. As other experiments have shown that the carbonic acid produced by the roots only causes a slight difference in comparison, the decrease in the yield must be attributed to toxic substances, the action of which is not diminished by raising the temperature of the solution to 120°C. for a period of twenty minutes.

Further, the water in which the root system of the peas developed, contained organic nitrogenous substances in solution. Cultures of maize in water in which peas had been grown and vice versa failed to reveal any specific action on the part of the secreted substances.—Bull. Internat. Inst. of Agric.

INFLUENCE OF CALCIUM AND MAGNESIUM COMPOUNDS ON PLANT GROWTH.

F. A. WYATT.

Some investigators seem to question the advisability of using magnesium-bearing minerals in agricultural practices, since they deem magnesium detrimental to optimum plant growth. Magnesium in some forms is detrimental to plant growth. However, the natural carbonates, such as limestones

and dolomites, are not detrimental but in reality beneficial to plant growth when applied in amounts sufficient to neutralize soil acidity. Plants were found to grow and mature normally in pure dolomite and limestone.

In scientific circles considerable attention has been paid to the theory that calcium and magnesium must occur in a different ratio for the optimum production of crops. LOEW claims to have proposed this theory in 1892, and much work has been conducted along this line, especially during the last decade. From the data presented in the following pages it will be seen that the ratio, within wide limits, had no effects.

The presence of sufficient quantities of calcium and magnesium in all soils is essential for the profitable production of crops. Various forms and quantities of these two elements may largely control the yields and composition of the harvests.

It is a well known fact that plants will tolerate larger amounts of an essential element than they require. The quantity of calcium and magnesium taken up by plants is dependent upon the amount available and upon the kind of plants. The silicates of calcium and magnesium are relatively insoluble, while the chlorides are very soluble. Dolomite is denser and less soluble than limestone but more soluble than magnesite. Synthetic compounds of magnesium are more soluble, however, than similar compounds of calcium.

Alfalfa, when grown in sand and soil cultures with varying amounts of calcium and magnesium minerals, such as dolomite and magnesite, also with prepared compounds of these two elements, such as the chlorids, sulphates, and carbonates, was found to contain varying amounts of calcium and magnesium. Some treatments showed as much as 52·5 pounds of calcium and 12·98 pounds of magnesium per ton of dry alfalfa. However, the above amounts were in excess of the absolute requirements, as smaller applications gave as large yields and the alfalfa contained only 28 lb. of calcium and 8 lb. of magnesium per ton of dry matter. On this basis 6 tons of alfalfa with a high-calcium content would contain 315 pounds of calcium and 77·88 pounds of magnesium, or the equivalent of 787·5 pounds of calcium carbonate and 272·5 pounds of magnesium carbonate. Wheat straw, when grown in pure dolomite, contained 14·48 pounds of calcium and 14·6 pounds of magnesium per ton, whereas when grown in the absence of excessive amounts of these two elements the straw contained only 5·96 pounds of calcium and 5·43 pounds of magnesium per ton.

REVIEW OF THE LITERATURE.

Solution cultures and pot cultures have contributed largely to our present knowledge of plant nutrition. WOODWARD found that the solid particles of the soil furnished nourishment to the growing plants and that water acted only as a carrier.

WOLF found by using beans and maize in controlled solutions, that the concentration as well as the kind of salts in the solution effected plant growth. His results show that when the concentration of the external solution was more than 0·25 per cent. it became the controlling factor; whereas if less than 0·25 per cent. absorption was controlled by the solution within the roots.

DASSONVILLE found that cutinization and lignification of the epidermis of leaves occurred much more rapidly in distilled water than in nutrient solutions; also that the growth of hemp and buckwheat was not influenced by the presence or absence of calcium and magnesium.

The crop is the measure of the resultant of all factors. In accordance with the present knowledge any one or many of the factors can be controlled. Likewise, the total amounts of the elements essential for crop production can be quantitatively determined.

Magnesium is essential for the growth of any living cell. Calcium is likewise essential except for the lower fungi and lower algae, which alone are able to exist without it. Loew shows that neutral oxalates are not poisonous to the lower fungi. He attributes the deleterious effects in higher plants to the change in the structure of the calcium-protein compounds, due to the formation of calcium oxalate, while the disturbance is brought about by the change in imbibition caused by the formation of potassium-protein compounds, and that magnesium may bring about this change provided there is a deficiency in calcium.

Reed found calcium to be necessary to the activity and growth of chlorophyll-containing organs. Willstatter has pursued in detail the study of chlorophyll and finds it to be a magnesium compound with generally three times as much green pigment as yellow pigment. He found that the magnesium content of chlorophyll was constant in both land and sea plants; therefore, it must function other than as a catalyzer. Pfeffer, Macdougall Pierce and others believe magnesium and calcium play an important and necessary function in plant synthesis and cell formation, but are unable to assign any specific rôle to either of these elements.

There has been considerable contention as to whether calcium could be replaced by other members of the group. Haselhoff grew beans and maize in solutions containing varying quantities of calcium and strontium and concluded that strontium seemed to take the place of calcium, replacing it only when the supply of calcium was inadequate. But it must be remembered that he first used calcium and strontium together in the solution and later reduced the calcium. However, Loew was unable to substantiate these results when he used species of Tradescantia.

Loew explains the toxicity between calcium and magnesium as being due to the formation of an insoluble condition of the phosphoric acid being fixed by the calcium, and that the framework of the nucleus and plastids is a double organic salt of calcium and magnesium. However, Meurer and Nathansohn offer another explanation. Cells being selective in their absorption of ions can check osmosis before a balance is reached between the solution within and without the cell, and the absorption of salts does not increase proportionally with the increase of concentration of the outside solution. Osterhout using calcium nitrate and magnesium nitrate was unable to substantiate Loew's assertion.

Considerable work has been done upon the antagonism of respective salts for each other in solution, Kearney shows that calcium salts are most beneficial in reducing toxicity. Lipman reports toxicity between magnesium and sodium but not between magnesium and calcium.

Numerous investigators have sought answers to the proposed theory of a lime-magnesia ratio with just as numerous and conflicting results. Solutions, pot cultures of soil and sand, and field soils have all been employed in attempts to settle the controversy. Ulbricht showed that yellow lupines, barley, and vetch were injured by applications of lime, especially when it

contained high percentages of magnesia. Magnesia apparently increased the proportional yield of grain in the case of barley and lupines. DOJARENKO, however, concluded that the theory of definite calcium-magnesium ratio was not tenable, as many Russian soils containing great excesses of calcium over magnesium were benefited by liming.

The results of water and soil cultures by GÖSSEL failed to substantiate the theory of a definite ratio of calcium to magnesium. He obtained the highest yields for beans and barley with water cultures when the ratio of lime to magnesia was 0·04 to 1, and concluded that the effect of liming is dependent upon the character of the soil and not upon a definite ratio of lime to magnesia. About this same time the Japanese investigators were actively engaged with the problem. However, their results all seem to bear out the theory of a definite ratio.

KONOVALOV, a Russian investigator, reports studies with barley, millet, oats, and maize, varying the ratio of calcium oxid to magnesium oxid, as follows: 13·4 to 1, 6·7 to 1, 3·3 to 1, 0·8 to 1, and 0·4 to 1. He found that the yields tended to increase with the increase of lime application, provided the magnesia content remained constant. Notwithstanding these results, VOELCKER states that the ratio is best at 1 to 1.

MEYER found that with buckwheat and oats the dependence of maximum yields on a definite ratio of calcium magnesium could not be proved even in the case of soils containing more calcium than magnesium or vice versa. Undoubtedly the most extensive investigations regarding a definite calcium-magnesium ratio have been conducted by LEMMERMAN *et al.* They used six different soils and grew vetch, oats, barley, rye, wheat, clover, mustard, and buckwheat, with the investigations extending over three years, 1907 to 1909, inclusive. From the standpoint of yields the ratio had no effects within wide limits. STEWART reports soils having 16·88 per cent. of calcium oxid and 6·1 per cent. of magnesium oxid which were cropped for 40 years without the addition of fertilizers, except in the case of sugar beets, which received manure. The 8-year average yields are 80 bushels for oats, 50·4 bushels for wheat, 262·3 bushels for potatoes, and 21·8 tons for sugar beets.

WARTIADI used sand and water cultures with wheat and barley and found that calcium and magnesium were beneficial or detrimental in proportion to their relative amounts in the culture solution. RUSSELL finds no connection between the lime-magnesia ratio and the productivity of the soil. HASELHOFF also failed to substantiate LOEW's theory, while HOPKINS found magnesium carbonate beneficial up to 0·8 per cent. when added alone in connection with calcium sulphate in such amounts as to maintain a ratio of 4 to 7, respectively, of magnesium oxid and calcium oxid.

GILE reports that with the chlorids of calcium and magnesium at low concentrations the ratio exerted no influence, while at high concentrations it was effective. Good yields of pine-apples were produced from soils in Porto Rico when the ratio varied between 1 to 13 and 73 to 1; and in one field where the ratio of calcium oxid to magnesium oxid was 1,461 to 1 a yield of 60 tons of sugar-cane was realized.

PISCIOTTA, an Italian investigator, reports the analysis of 50 soils which show a wide variation in the lime-magnesia ratio, due to the variation in the

lime content. PATTERSON found that magnesian lime which is claimed to be poisonous, gave the highest yields.

In summing up the literature studies previously mentioned, it will be seen that LOEW and his associates and Japanese students maintain the theory of a definite lime-magnesia ratio, as do ULBRICHT and WARTIADI, whereas DOJARENKO, GOSSEL, KONOVALOV, MEYER, LEMMERMAN, HASELHOFF, GILE, and PATTERSON claim that a definite ratio of lime to magnesia is not tenable and, furthermore, lacks substantiation.

LEMMERMAN *et al.* have undoubtedly conducted the most extensive investigations upon this subject and conclude that there is no correlation between maximum crop productions and the ratio of lime to magnesia. Soils reported by RUSSELL and by GILE show wide variations in the lime-magnesia ratio, also in the percentages of these two elements, and that there fails to be any correlation between the productivity of a soil and its ratio of lime to magnesia.

Solution cultures show that a specific ratio of lime to magnesia is not equally effective in dilute solutions and in concentrated solutions. This indicates that the effectiveness is dependent upon the total balance of all the salts in solution instead of merely the ratio of calcium to magnesium.

The preponderance of evidence appears to be against a definite ratio of lime to magnesia, especially with respect to soil cultures in pots and under field conditions. What really seems of first magnitude is the resultant of all factors—that is, the climate, the plant, and structure, reaction, micro-organic activity, and composition of the soil.

CONCLUSIONS.

(1) Wheat, soybeans, alfalfa, and cowpeas grew normally either in 96 per cent. of dolomite and 4 per cent. sand, 100 per cent. of magnesium lime-stone, or in sand containing 7 per cent. of magnesite.

(2) Dolomite up to 40 per cent. proved beneficial to plant growth. These results indicate that dolomite and magnesian limestone will not be detrimental as applied in agricultural practices.

(3) Applications of prepared magnesium carbonate up to 0·7 per cent. caused no injury in brown silt loam, but 0·35 per cent. prevented the growth of all plants tested in sand.

(4) The crop yields and the ratio of calcium to magnesium in the plants bear no direct relation to the ratio in the natural carbonates applied.

(5) Different ratios of calcium to magnesium within rather wide limits produced no marked differences in yields.

(6) Increasing the size of applications increased the calcium and magnesium content of plants.

(7) A tolerance of calcium and magnesium occurred in all varieties of plants grown. With approximately identical yields, wheat straw grown in sand, brown silt loam, dolomite, and soil containing 35 per cent. of magnesite showed calcium contents varying between 0·165 per cent. and 0·547 per cent. and magnesium contents varying between 0·132 per cent. and 0·955 per cent.

(8) Acid extractions failed to remove all the calcium and magnesium from the sand. There remained after the various extractions from 768 to 852 mgm. of calcium and from 540 to 960 mgm. of magnesium per 6,000 gm. of sand.

(9) The plants possessed a decided ability to obtain calcium and magnesium from sand extracted with strong hydrochloric acid, as borne out by the following example: Three crops of alfalfa removed from acid extracted sand 164·43 mgm. more calcium and 90·4 mgm. more magnesium than was contained in seeds similar to those planted.—JOUR. OF AGRIC. RESEARCH.

ASHES AS A FERTILISER.

R. D. ANSTEAD.

A number of samples of different kinds of Ashes have been examined in the laboratory in Bangalore during the year and they appear to be used fairly frequently on estates now that there is a shortage of Potash.

The benefit derived from Ashes is due to the combined effects of the very finely divided Calcium carbonate and Potassium carbonate which they contain.

The following table shows the composition of some of the samples examined :—

Ashes derived from.	Potash.	Phosphoric acid.	Lime
Tobacco Waste ...	26·96	...	...
Galinsoga parviflora ...	24·27	4·28	5·94
Cow Dung ...	16·49	1·40	3·50
Wood Ashes ...	4·37	3·66	36·06
	3·83	1·73	38·33
	3·73	3·42	47·85
	3·05	2·51	7·47
Jungle Wood ...	2·95	...	...
Etzel Grass ...	4·10	...	6·16
Paddy Husk ...	0·89	...	...
Bracken Fern ...	1·97	...	...

It will be seen that the composition of these ashes varies a great deal, especially the composition of Wood Ashes depending on the material from which they are made. This latter class of ash contains a very large amount of Lime.

As wood matures the proportion of Potash and Phosphoric acid decrease while that of Lime increases so that the ash of old wood is not so valuable as that from young branches and leaves, in which Phosphoric acid and especially Potash largely occur, and whenever possible such material should be chosen in preference to old wood for the preparation of Ashes for agricultural purposes.

The Ash from Tobacco Waste is a most valuable source of Potash and one which should be developed.

The CHEMICAL NEWS of 2nd June contains an article by MR. BURRELL on "the National Waste of Tobacco Ash" from which the following extract is quoted :—

"It is well known that all parts of the tobacco plant are rich in potash. In America the stems and waste from the factories are already being utilised.

"The portion used for smoking is the leaf, and it may be stated that in round numbers the ash (including unburnt tobacco) from a pipe, cigar, or cigarette is about 30 per cent. and that one-fifth of this, or 6 per cent., is potash; or in 100 parts of ash there are potash salts equivalent to 20 parts of potash.

"Tobacco ash is thus extremely rich in potash. It may be regarded as the by-product in the operation of smoking, and at the present time this valuable by-product is being completely wasted, whereas by a little organisation a great deal of it might be saved and used as a source of potash. Tobacco ash also contains another fertilising ingredient, viz., phosphoric acid, to the extent of about 5-6 per cent.

"It is I think a matter of common agreement that as a nation we shall in the future have to practise the most rigid economy, and that we must try to reduce our imports as much as possible. One of the imports that could be reduced or stopped are the German Potash salts.

"We have commenced to make our own dyes, chemical and optical glass, porcelain and filter papers: then why not try to be independent of German potash and stop the daily waste of potash in tobacco ash and household vegetable refuse. The latter does not, however, come within the scope of this note.

"By the systematic collection of tobacco ash from pipe tobacco, cigars, and cigarettes, hotel and restaurant keepers would be doing a national service and at the same time add to their incomes. I would suggest that every hotel, restaurant, and public house should have its tobacco ash tub, into which tobacco-ash trays from the smoke room, etc. should be emptied, and that they form a combination for its collection and sale to the artificial manure maker or the manufacturing chemist.

"The material is there; in any case it has to be collected; but instead of throwing it away, as at present, it should be utilised.

"Every district should have its potash recovery department, which should work up not only tobacco ash but household vegetable refuse and vegetable waste from the markets and greengrocers' shops. Such a scheme would help to provide employment for our own people and to materially lessen our imports.

"In order to put the matter as fairly as possible the following illustrations are given:—

"An ordinary sized cigar will measure about $4\frac{3}{4}$ inches by half an inch, and will weigh about 106·5 grains. If carefully smoked it will take about one hour to burn and will give about 32·3 grains of ash, of which one-fifth, or 6·5 grains, is potash.

"An ordinary sized cigarette will weigh about 27 grains, will take about twenty minutes to burn, and will give about 8·5 grains of ash, of which one-fifth, or 1·75 grains, is potash.

"An ordinary sized pipe will hold about 25·5 grains of tobacco, will burn for about twenty minutes, and will give about 8·0 grains of ash, of which one-fifth, or 1·60 grains, is potash.

"Now take some results of systematic collecting:—

1. Tobacco ash and unburnt tobacco from the smoke room of a club, collected for eight days, weighed $9\frac{3}{4}$ ounces.

2. From the lounge of a large hotel, collected for four days, weighed 13 ounces.

3. From a large restaurant, collected for ten days, weighed 2 lb. 8. oz.

4. From a music hall, one-tenth part of the auditorium, one performance only, weighed four ounces.

"If it is remembered that this ash is being produced all over the country day by day we can begin to appreciate the quantity of valuable matter that is being wasted.

"By the kindness of MR. MURGATROYD of MESSRS. HARDY & CO., tobacco and cigar importers, I am enabled to give the actual amount of tobacco and cigars consumed in the United Kingdom for one year, March 31st, 1913, to March 31st, 1914. Tobacco was 98,412,412 lb., the total population being 46,407,037, or an average consumption per head of the population of 2·08 lb. During the same period the imported cigars consumed weighed 1,331,802 lb.

"I have converted MR. MURGATROYD's figures into tons, so as to be more easily grasped. The total consumption of tobacco and cigars in tons comes to (in round numbers) 44,529. This when burnt will give 13,359 tons of ash. If we assume that the ash contains one-fifth of its weight of potash (which is a low estimate) we get 2,672 tons of potash, and as kainit only contains 12·5 per cent. of potash we may say that we are annually throwing away potash equivalent to 21,376 tons of kainit. In the spring of 1914 the cash price of kainit at Goole was £2 7*s.* 6*d.* per ton, so that this quantity of kainit would be worth nearly £51,000. In the spring of 1915 it was worth nearly three times as much.

"From these figures there would, of course, have to be considerable reductions for unavoidable wastage."

Galinsoga parviflora is a very common weed on Tea and Coffee Estates and one which should be encouraged and always dug in when found so as to conserve its valuable constituents. My attention was first called to the high Potash content of the Ash of this plant by my friend and colleague DR. HARRISON, the Government Agricultural Chemist. The sun-dried plant contains about 18·20% of Ash which Ash contains about a quarter of its weight in Potash. Another valuable form of Ash is that derived from Cow Dung or Bratties.

The Ashes of Bracken Fern are disappointing. The Ash of Bracken Fern was recommended as a source of Potash in England and said there to contain 20% or more of Potash, but two samples examined here contained a very large proportion of insoluble matter and very little Potash. The reason for this is not clear, it possibly has something to do with the soil on which the Fern is growing.

It has often been stated that Soda may be substituted for potash. Whilst in a measure true this bald assertion needs some qualification. When in any soil certain mineral elements of plant food are lacking they may in some degree, but not in their entirety, be replaced by other nearly allied elements, and to some extent soda replaces potash, but not altogether and not sufficiently to render the latter unnecessary. The idea could be easily carried too far. Our soils are not as a rule lacking altogether in Potash and comparatively small applications are found in practice to suffice. Sources of Potash deserving consideration at a time like this are Ash of all kinds.

In any system of manuring at the present time it would seem that the safest and most economical plan to adopt is to Lime the soil and then apply organic material which on decomposition supplies Nitrogen, and then Phosphates and any Ash available.

The effect of Lime followed by Phosphates will be to materially hasten the decomposition of Silicates and insoluble forms of Potash in the Soil with the production of Potash available to the plant. At the same time the Phosphates are most essential when the berry is the chief object of attainment in the crop.—THE PLANTERS' CHRONICLE.

SERICULTURE IN SOUTH INDIA.

T. V. RAMAKRISHNA AIYAR.

(Continued from p. 181, Vol. XLVII.)

THE CARE AND TREATMENT OF THE WORMS.

Neither the Kollegal nor the Berigai rearer has yet understood that a great deal of the success in silkworm rearing depends upon the proper nursing and treatment of the worms during their feeding stage.

FEEDING.

In both Kollegal and Berigai the worms are fed seven to nine times daily including two or three times at night. Leaves are chopped up finely and sprinkled over tender worms. As the worms grow the fineness in chopping is gradually reduced until at last after the fourth moult entire leaves are given. During the moulting period for a day, no food is given.

CHANGE OF BED.

This operation is done once every day at noon. The process is very crude. A tray full of worms and droppings is gently kept slanting over another clean tray and the worms with the fresh leaves are gently pushed by the hand into the clean tray. In this process a good many worms get choked while some get jammed and die.

THE DISPOSAL OF THE LITTER.

The droppings of the worms with old leaf matter are heaped very often close to the meja and here the ryot's cattle feed on the litter greedily. Cattle fed on silk worm litter are said to grow very healthy. In Berigai the litter is kept heaped to dry and later on applied as manure to mulberry lands. Very little attention is paid to the ventilation or space required for the worms. The trays are crowded and in this way many worms die for want of proper room. Sometimes for want of sufficient number of trays the worms are crowded together in a few trays and never thinned as they grow bigger.

TRANSFER TO SPINNING SCREENS.

When the worms become ripe and get a translucent colour they are collected and put on to the *chendrikes*. The transferring is very crude. The ripe worms are collected and kept in baskets like vegetables near chendrikes. Handfuls of worms are taken each time and sprinkled upon the chendrike. In this process alone a good many worms become weakened. During the cold weather the chendrikes with the spinning worms are exposed to the sun for some time and this is said to aid the worms spinning actively. The cocoons are removed from the spinning screen the very next day after they are formed. They are then exposed to the sun and then stifled with steam.

COCOON STIFLING.

This process is done as follows:—A vessel of water is kept upon a fire and the water boiled. As it boils a basket full of cocoons is placed over this vessel and the mouth covered by means of a cotton sheet or blanket. It is kept in this position for a few minutes. When the heat of the steam begins to be felt upon the sheet the basket is removed and the cocoons in it which are all by then stifled spread out and kept ready for reeling.

SILK REARING.

Just as the mulberry grower and worm rearer are different individuals, the worm rearer and the silk reeler are also very often different persons in Kollegal. In Berigai the same man grows mulberry, rears the worm and reels the silk. Silk reeling is done in both these places almost exactly in the same manner and with the same apparatus. In Kollegal one man often maintains a sort of filature where he has from two to fifteen or twenty reeling machines. In other cases each householder has one or two machines with which he reels out his crop of cocoons. In Berigai there is no filature of any kind. Each man has a small apparatus for reeling and gets his cocoons reeled with it.

REELING APPARATUS.

The reeling apparatus is a very simple and cheap mechanism and is worked by two persons, one the cocoon reeler and the other the winder. It consists of the following three parts :

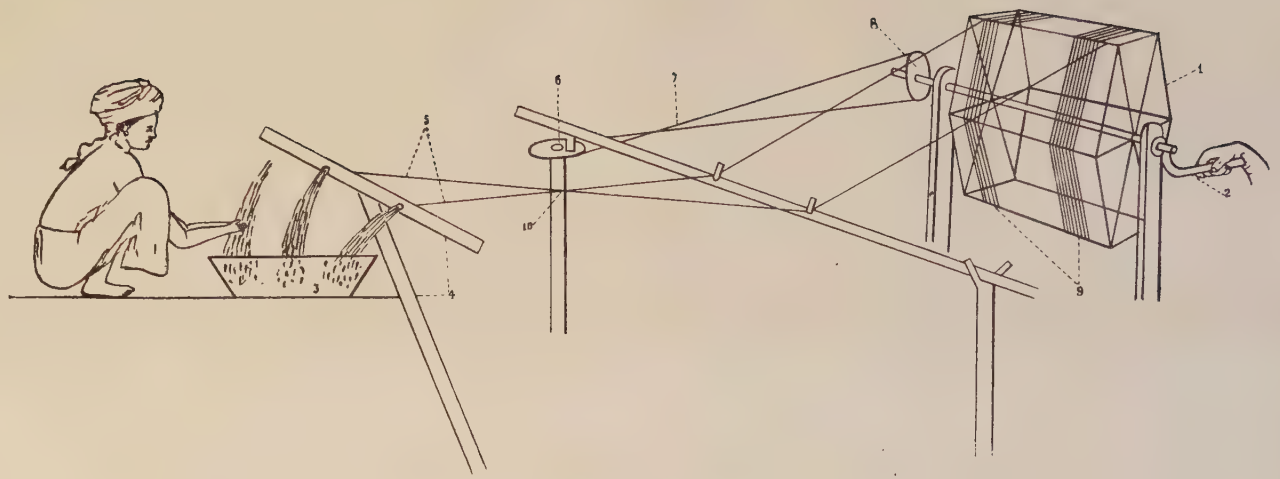
(1) At one end is the reel (rattle or 'charka') which is a wooden wheel-like structure revolving on a horizontal axis, with a handle at one end of the axis. It is to this wheel that the silk thread reeled from the cocoons is wound up in what are called skeins or '*ladis*.'

(2) At the opposite end is a basin of boiling water with the cocoons inside. The reeler sits close by and reels the cocoons. Kept slanting over the basin is a T-shaped rod called *Tharpatte ;* the horizontal portion of this T is a flat metal piece with two holes bored. The reeled silk threads from two sets of cocoons in the basin are made to pass through these holes in the T before they pass on to the reel.

(3) Between the reel and the oven with boiling water is a cross wooden piece over which the silk threads pass on to the reel; this rod moves right and left when the reeling goes on, the object of the motion being to distribute the silk threads evenly on the reel two or three inches in breadth preventing all the thread winding in one place. This lateral motion is brought about by the help of an eccentric arrangement and connection between the rod and axis of the reel. A pulley at one end of the reel axis called *Dindu* is connected by a cord to a rough eccentric or *Rāikallu* attached to the cross piece or rod. While the reel is turned, this arrangement moves the cross piece laterally.

Just after leaving the holes in the *tharpatte* or T piece the silk threads are made to cross each other. This Croisure or *Kainchi* is said to be useful in agglutinating the fibres or *baves* from the different cocoons which go to form a fibre and giving the thread a uniform thickness.

The whole reeling apparatus costs from Rs. 2/8/- to Rs. 3/- the only costly portion is the reel which costs about Rs. 2/4/-. The price is a little



SKETCH OF A KOLLEGAL REELING MACHINE.

1. The reel or rattle on which the silk thread winds in skein.
2. The handle of the reel for working the same.
3. The basin of hot water with cocoons being reeled by the reeler.
4. The T piece through the holes of which the silk fibres pass.
5. The silk threads.
6. Pulley on which the eccentric rests.
7. Cord connecting eccentric with reel.
8. Pulley at the axle of the reel to which No. 7 is attached.
9. The two bundles of silk threads on the reel-skeins.
10. The "croisure" of the two silk threads.

more when the reel is constructed for taking four skeins of yarn instead of two. The reeler and winder are both males in Berigai; while in Kollegal the winder is a little girl or old woman who gets only from $1\frac{1}{2}$ to 2 as. a day. The reeler gets from 4 to 8 as.

On an average each reeling machine worked by two labourers reels about 35 seers of cocoons into $3\frac{1}{2}$ seers of yarn and about two seers of waste called *Jot* or *Netti* every day. If the reeler is a good hand the out-turn of silk yarn will be less but of superior quality, and proportionately in this case there will be more waste silk. The majority of South Indian reelers only aim at getting quantity and not quality. Generally it is said that from a maund of cocoons four seers of inferior, 3 seers of medium or $2\frac{3}{4}$ seers of the best quality of yarn could be obtained. This depends a great deal on the skill of the reeler. The reelers of Hinduvadi, Kamakarai, Agaram and Mampallee are said to be famous and the silk of Hinduvadi is taken as the type of the best silk in Kollegal.

DISPOSAL OF PRODUCE.

The silk produced by the cultivators is exported in all conditions from Kollegal. But there is a great deal of export in the form of yarn. In Berigai cocoons are not sold but only reeled yarn. As cocoons, silk sells at an average price of Rs. 12 to $12\frac{1}{2}$ per maund in Kollegal. There was till recently a European cocoon depot at Mudigundum near Kollegal town where cocoons were purchased from local rearers in quantities, ovened and forwarded to up-country filatures, chiefly in Bengal. The price of silk yarn varies from Rs. 125/- to Rs. 170/- a maund. For the purchase and export of silk yarn there are a number of local agents from different silk weaving centres of South India, such as Kumbakonam, Koranad, Conjeevaram, Madura, Arni, etc. The price of yarn is fluctuating and depends upon the demand and the stock. These agents more or less control the market. They purchase yarn in quantities and forward to their places. The months June—August form a busy season in the year for the purchase of yarn as the quality of the silk is said to be superior then. The reel waste or *Jot* which is made up of waste silk in reeling and pierced cocoons also command a sale, though some years ago it had no market. This material is purchased at from Rs. 12/- or 15/- to Rs. 20/- a maund by agents of European Carderies where it is spun like cotton and often mixed with cotton and woven into fabrics which go by various fanciful names as mercerised silk, Tassurret, etc.

In Berigai there is no one who purchases cocoons. All silk is sold as reeled yarn either at Bangalore or some other silk centre in Mysore.

There is also some weaving carried on locally both at Kollegal and Berigai. At the former place silk cloths worth Rs. 100/- and more with lace work are woven. The greater portion of the silk produce leaves the taluq however as yarn.

CO-OPERATION.

CO-OPERATIVE FARM IMPLEMENT SOCIETIES.

Every farmer agrees that the fullest possible use should be made of implements and machines at the present time. Farmers who have well-filled implement sheds are regarded as fortunate by their neighbours, and many whose farms are too small to justify an expensive outfit would now be glad to purchase mowers, swath-turners, binders, spring-tooth cultivators, seed drills, etc. The war, which has depleted farms of men, has caused the manufacturers of machines and implements great difficulties, and many of them are quite unable to cope with the orders they receive. To meet these conditions the attention of farmers is directed to the formation of Co-operative Implement Societies. In recent years such societies have been successfully established in different parts of the United Kingdom. At the present time the formation of societies to provide harvesting machinery would be specially useful. A self-binder is an expensive purchase for a man with only 20 acres or so under corn and, even if the small corn grower were ready to buy, it would be very undesirable that in a year when the supply of machines is limited, a binder capable of harvesting 75 to 150 acres should stand idle on a farm growing no more than 20 acres of white crop. In those districts in which farms with 10 to 50 acres of corn are numerous, and especially in districts where the harvesting period is prolonged, the formation of clubs or societies to provide binders would greatly aid the labour problem. Such societies might further arrange for the sharing of workers and horses, and this would be a special advantage in districts in which both low-lying early farms and high-lying late farms occur. While the approaching harvest is the first matter for which co-operative implement societies are wanted, their usefulness may be made to extend through the year, and the following examples and notes are printed for the guidance of those who wish to adopt this means of meeting labour troubles.

EXAMPLES OF CO-OPERATIVE IMPLEMENT SOCIETIES.

In Ireland a co-operative farm implement scheme has been in operation since 1912. Under this scheme it has been found possible to place at the disposal of farmers who become members of a co-operative implement society, practically every farm implement from a one-horse plough to a high power agricultural tractor, and this at a merely nominal outlay of capital on the part of individual farmers. In the case of one society, which may be mentioned as typical of others, agricultural implements to the value of £250 have been purchased for the use of the members, the implements including an oil engine, thresher, corn binders, potato diggers, and disc harrows. Convincing testimony of the benefits conferred by these societies is supplied in the rapid increase in their numbers.

In England prior to the war there appear to have been no societies having for their sole object the joint ownership of implements, though several agricultural co-operative societies owned agricultural machines for the use of their members, more especially small-holdings societies. Since the outbreak of war, however, farm implement societies have been formed, or are in process of formation, at Holt, Hayling Island, Brandsby, Knutsford, and the Isle of Wight. At Knutsford the society is starting with a capital of £1,000 found by the farmers themselves. The society in the Isle of Wight was formed by twelve farmers, and has purchased a steam plough, which is now saving time and expense by doing the work formerly done by horse and hand labour. The necessary capital has been raised by each farmer taking up 200 £1 shares, of which 1*s.* per share is paid up, and obtaining an overdraft at the bank to the extent of the uncalled capital.

FORMATION OF A SOCIETY.

Where it has been decided to form a co-operative farm implement society, the first step should be to apply to the Agricultural Organisation Society (Queen Anne's Chambers, Tothill Street, Westminster, London, S.W.) for expert advice and assistance. The society will supply a memorandum containing suggestions for the formation of societies and the framing of by-laws.

WORKING OF SOCIETIES.

If a projected society is to prove a success, the following points must be carefully considered:—(1) The implement should be of a type for which there is a large demand in the district; (2) ample allowance must be made for depreciation; and (3) where steam or petrol-driven implements are used the engines should be kept as fully occupied as possible. In Ireland the rate charged to members for the use of the implements is about one-half of the cost of carrying out the various operations in the ordinary way. If, for instance, potato sorting by hand costs 15*s.* per ton, the potato sorter is hired out at 7*s.* 6*d.* per ton. A well conducted society will soon earn sufficient to pay for the initial cost of the implements. In many cases Irish societies commencing with two corn binders have in one harvest earned sufficient to purchase a potato digger. In its turn the potato digger has earned sufficient to buy a corn drill. By beginning in a small way like this a society's borrowing powers are automatically increased, and it is in a position to undertake the purchase of the more expensive implements such as agricultural tractors with their complementary implements, combined threshers and finishers, and moledraining plants. The actual working of a society can best be described by reproducing the bye-laws adopted by the Irish societies. These by-laws, which may be modified to suit local conditions, are as follows:—

1. All implements the property of the Society shall be hired to members and non-members of the Society at such rates and on such conditions as the Committee shall decide.

2. Applications for the hire of implements shall be made to an official of the Society appointed by the Society to receive same. The person making the application shall sign an undertaking to abide by the Society's Bye-laws, a copy of which should be supplied to him. The applicant shall also state the amount of work to be done, or the period for which he wants to hire the implements, or both.

(*a*) The person appointed by the Society to receive applications for the hire of implements shall always give precedence for the hire of implements to members of the Society over non-members,

(*b*) If the Committee consider that the applicant has understated the amount of work, they shall be empowered to appoint some independent person to survey the work performed. The expenses of the person so appointed shall be paid either by the Society or the applicant, whichever is proved to be in the wrong.

(*c*) Subject to the conditions stated in the previous clause, he shall hire out the respective implements in the same order as applications for same are received. If he receives two or more applications for the hire of the same implement at the same time he shall give precedence to the applicant who has the most work to perform with the particular implement.

(*d*) If two or more applicants have an equal amount of work to perform, precedence shall be decided by lot.

3. Any person, member or non-member, who has been granted the hire of an implement, must undertake, when he has finished with the implement, to convey it to the person who has been granted its use next, and must also, when necessary, instruct the latter person in the use of the implement.

4. In case of any person after obtaining the hire of an implement is unable to work it through lack of horses, or through his land or crops being in an unsuitable condition, or for any other sufficient reason, and any other applicant requires the implement for immediate use, it must be handed over to the latter immediately. After the latter has finished with the implement, the previous applicant may then, if ready to carry out the work specified in his application, claim his right to its use.

5. In the event of any damage occurring to any of the Society's implements the following course shall be adopted:—

(*a*) A notification must be at once made to the Secretary of the Society.

(*b*) All implements shall be repaired and kept in good working order at the expense of the Society, irrespective of whether they are damaged whilst working for a member or non-member. In case, however, an implement is damaged through what the Committee consider to have been culpable negligence, the cost of repairing same shall be borne by the hirer on whose farm it was broken or damaged.

6. Any unusual circumstance necessitating an alteration in the order of precedence in dealing with applications for the hire of machinery, such as breakage, may be dealt with by the Secretary or Manager in consultation either with a Committeeman, or the Agricultural Expert of the nearest agricultural co-operative society, provided the matter is reported to the next meeting of the Committee.

7. Payments shall be made by hirers of machinery and implements at such times and in such manner as the Committee may decide.

8. The Committee reserve to themselves the right to reject the application of any person who is not a member of the Society, without stating their reasons for so doing.

9. The Society shall not be held responsible for any failure on its part to supply its members or other contracting persons with machines or implements, provided such failure shall be due to strikes, labour disputes, unavoidable delay in delivery of any machine or implement, or any essential part thereof.—LONDON COMMERCIAL RECORD.

GENERAL.

REPORT OF THE GOVERNMENT CHEMIST FOR 1915.

During my absence from Ceylon on urgent private affairs from April 1st to 27th September, Mr. A. Bruce carried on my duties as Government Chemist.

While in England I visited the Charcoal and Acetic Acid Manufactory in the Forest of Dean with the Chief Engineer, who supervised the erection of the plant, and the Managers of two other Government Acetate factories to study the process thoroughly. The object in view was the starting of similar factories in the dry zone of Ceylon for the manufacture of Acetate of Lime, Acetic Acid and Charcoal from Virai (*Hemicyclia sepiaria*) and similar wood of no value for other purposes than fuel. An estimate of a plant for distilling from 3 to 5 tons of air dry hard wood per day of 24 hours producing charcoal, and the usual by-products including the manufacture of technical Acetic Acid was obtained.

The cost f.o.b. Glasgow was £3,705 sterling to which should be added the freight charges and the cost of necessary buildings approximately £5,000 in all.

Ten tons of Virai wood as supplied to the Ceylon Government Railway for fuel were sent to Colombo and distillations made with charges of 1 and 2 tons to ascertain the actual yields of the various products. These confirm previous experiments and compare favourably with woods employed for the same purpose in other countries, where the cost per ton is heavier than it would be in Ceylon.

The supply of Virai in parts of the North-Central Province and the Wanni is very large, the trees in certain areas forming about 60% of the forest, and it is proposed to erect a preliminary plant near the railway where the forest can be tapped for two or three miles on either side. As the production and demand develops similar plants would be erected in other centres.

The dry branches and leaves of the Virai yield a high percentage of ash 6·4%, containing 19 to 20% of potash, and it is proposed to manufacture carbonate of potash as a secondary product of the Virai trees.

Inquiries were also made at various nurseries as to suitable trees for re-afforesting the cleared areas or for planting up on patna land at higher elevations with a view to furnishing suitable timber in the future for tea boxes, etc., most of which has now to be imported.

The quick growing trees recommended were various conifers including the Corsican pine, American cotton wood, Swamp Cyprus Taxcodium distichum, and varieties of Populus.

RUBBER EXPERIMENTS.

The series of tapping and manuring experiments begun in 1913 have been continued during the year. Although the trees, which were planted in April, 1905, at 15ft. by 15ft. are now rather too close, it was decided not to thin out for another year, or until the present experiments are completed.

The tapping experiments as a whole in which area no cultivation or manuring was done, show an average increase in yield over 1914 of only 0·398 lb. of dry rubber per tree.

Two plots No. 78B tapped on a third with 4 cuts, one foot apart, once a week and No. 81C tapped on a third with 1 cut at 3 feet daily showed a decreased yield of 0·04 lb. and 0·37 lb. per tree respectively. Contrasting the results of tapping with 4 cuts on one-third of the trees, once, twice and three times a week, the average yields per tree from each system respectively were 2·02 lb., 4·01 lb. and 4·52 lb. or a ratio of 1; 1·98; 2·24.

To compare the effect of changing over every three months on Plot 78C 17 trees are tapped on the quarter system with one cut to the left at 15 in. on alternate days, and a further 17 trees in the same manner, but changing over to the opposite quarter every three months. The yields per tree were:—

	1914	1915	Increase per tree in second year.
Tapping alternate days ...	2·25 lb.	2·26 lb.	0·01 lb.
,, ,, and changing every three months ...	1·98 ,,	3·03 ,,	1·05 ,,
Increase in favour of changing ...	0·27 ,,	0·77 ,,	or an average

annual increased yield of 32·5% or about 11¾oz. per tree.

During the first year the effect of changing over was a lower yield, followed by a marked increase in the second year; while the yield from the continuous alternate day tapping on one side was practically stationary.

Comparing the single V on one-third of the tree with one cut left to right on the third, both with alternate day tapping, the former gave a greater increase per tree in 1915 over 1914, but the single cut gave rather more yield per tree in each year:

	1914 lb.	1915 lb.	Increase per tree.
80C Single V on 1/3 at 3 ft. tapped on alternate days...	2·53	3·13	0·60 lb.
8CC ,, / ,, ,, ,, ,, ...	2·75	3·20	0·45 ,,
Increased yield from one cut over the V ...	0·22	0·07	

or an average of 2·4oz. per tree per annum.

The effect of two cuts on 1/3 at 1 ft. and 2 ft. apart respectively, tapped three times a week is in favour of the former, the yields being 3·75 lb. and 4·0 lb. per tree in 1914, and 1915, respectively compared with 3·0 lb. and 3·5 lb. from the wider spacing between the cuts.

Comparing the two cuts at 1 ft. apart with one cut at 3 ft. left to right both on 1/3, but the former tapped three times weekly and the latter on alternate days, the average yield is 30·5 per cent. higher from the two cuts.

	1914 lb.	1915 lb.	Increase per tree.
Plot 80C 1/3 at 3 ft. on alternate days ...	2·75	3·20	0·45 lb.
,, 81A 1/3 at 1 ft. apart three times weekly	3·75	4·00	0·25 ,,
	1·00	0·80	

Tapping daily on alternate months gave rather better yields than on alternate days throughout the year and the decrease in 1915 was greater in the latter.

A considerable difference in yield was also shown in 4 cuts 1 ft. apart on ¼ of the tree compared with two V cuts at 1 ft. apart although practically

the same amount of bark was removed in each case.

	1913 lb.	1914 lb.	1915 lb.
4 cuts on $\frac{1}{4}$	2·10	3·12	2·80
2 V cuts on $\frac{1}{2}$	2·85	3·65	2·39
	0·75	0·53	0·41

The increase in favour of the two V's was 12oz. per tree in 1913, 8·5oz. in 1914 and about 6·6oz. per tree in favour of 4 cuts in 1915.

RUBBER MANURING.

All the manured rubber is tapped on alternate days on the 1/3 system with a single cut left to right at 23 in. from the ground, the tapping being done by one cooly.

The manures were applied in February, 1913, and again in 1915, the tapped trees in each row only being manured in the latter year.

The mixtures were made to demonstrate the effect of a general *organic* mixture, excess of nitrogen, potash and phosphoric acid and a general *mineral* mixture.

Each manured plot was separated from the next by one unmanured row of rubber.

The average yield per tree of the manured plots was

1913	...	1·23 lb.	
1914	...	2·41 ,,	96% increase
1915	...	3·29 ,,	36·6 ,,

The two plots receiving an excess of nitrogen and phosphoric acid gave the greatest increase in 1915 over 1914, viz., 1 lb. 1½oz. per tree while the excess potash plot gave less than the unmanured plot by 7oz. per tree.

The effect of cutting out the cocoa in these plots in 1913 evidently had a considerable influence on the rubber trees in 1914 the control plot nearly doubling its yield, and the manuring will have to be continued for some years before the relative value of any special constituent can be determined.

It is of interest, however, to compare the average yield of the trees from the uncultivated and the manured areas, all the rubber being of the same age.

	1914 lb.	1915 lb.	Average Increase or Decrease per tree.	Percentage Increase or Decrease.
Uncultivated area ...	3·09	3·30	3·15 oz.	6·87
Forked before 1913 and not since	3·39	2·60	12·60 ,,	23·40
Manured 1913 and 1915 ...	2·41	3·29	14·10 ,,	36·00

A detailed report of the tapping and manuring experiments will be published in a bulletin.

The average percentage of rubber in the latex from the unmanured and manured plots was 31·0 and 32·8% respectively. The smallest percentage, viz., 28·7% was in the latex from the trees tapped with 4 cuts three times a week, and highest 37·5% in the trees tapped in the same way once a *week* only.

Daily tapping with one cut also gave a lower percentage of latex 29·6% compared with 31·4% for alternate days.

The quantity of bark removed per tree from the manured plots from January 1st, 1914, to December 31st, 1915, was 16·78 inches, yielding 5·7 lb. of rubber or about 3·50 inches of bark for 1 lb. of rubber in 1914, and 2·55 inches only in 1915, the average yield per tree being 2·41 lb. and 3·29 lb. respectively.

The average thickness of bark 1 inch above the tapped area and 1 inch below the first cut, i.e., representing about 23 months renewal from the

unmanured and manured trees is:—

	Original Bark.	23 Months Renewal.
Unmanured	6·61 mm.	3·60 mm.
Manured	6·86 mm.	3·94 mm.
	0·25 mm.	0·34 mm.

representing an improved thickness in the manured bark of 3·9% in the original and 9·4% in the renewed bark,

Excess of potash and the mineral mixture had the greatest effect on thickness of bark, the latter increasing the original by 11·4% and the renewed bark by 19·5% while phosphoric acid had the least effect. It has still to be shown that a thicker bark will necessarily give more latex, as careful measurements of six poor yielders, and six good yielders gave the following figures:—

	Thickness of bark 1 in. above cut.	Thickness of bark 1 in. below cut.
Poor yielding trees ...	6·25 mm.	4·00 mm.
Good yielding trees ...	6·16 mm.	3·60 mm.
	0·09 mm.	0·40 mm.

or 1·46% better thickness of original bark and 11·10% better renewed bark in the poor yielding trees.

Comparing the thickness of bark for 36 trees along the outer edges of the plots where there is ample air and light with 36 trees about 6 rows or 110 feet inside, the thickness was 6·64 and 6·69 mm, a difference almost negligible. Another point of interest is that the increase of girth in 1915 compared with 1914 was rather less on the manured trees than the unmanured, the average girth of all the trees under tapping being 35·27 inches in July 1915:

	Mean increase in inches 1914	1915
Unmanured	4·69	3·53
Manured	4·37	3·24
Difference ...	·32	·29

The rainfall and number of wet days for the two years were:—

	1914	1915
Rainfall	82·72 ins.	87·59 ins.
No. of wet days	178	153

The difference in climatic conditions was comparatively slight, and the smaller development in the trees in 1915 is probably due to the effect of slight overcrowding.

TEA PLOTS.

The green manuring treatment of these plots with an application of slag and potash at pruning has been continued and large yields are still obtained, especially from the dadap and Albizzia plots.

The 15 acres of single Assam hybrid and Manipuri indigenous now easily run two years between prunings, the dadap plot yielding in the 23 and 24 months pruning as much as 134 and 127 lb. of made tea per acre per month. The characters of the wood in the plots not treated with green manure for some years especially Nos. 147 and 148 is beginning to deteriorate and compare unfavourably with the dadap and Albizzia plots Nos. 149 and 150.

The total yield of tea from the three varieties grown viz. Singlo, Assam hybrid and Manipuri indigenous (dark leaved), for the periods between the

last two prunings, both with and without rubber shade are:—

	lb. per acre.	
Singlo jat without rubber shade ...	1,820 lb.	
,, ,, with ,, ,, ...	640 ,,	difference of 640 lb. or 50%
Assam hybrid without ,, ,, ..	1,775 ,,	
,, ,, with ,, ,, ...	640 ,,	difference of 1,135 lb. or 64%
Manipuri indigenous no shade ...	2,273 ,,	

The loss of crop due to the shade of the rubber and competition with the rubber roots is clearly demonstrated.

In all the plots except No. 143, where the prunings have been buried since 1911, the alternate lines are deeply forked and the prunings heaped, an application of 100 lb. of basic slag and 60 lb. of sulphate of potash being applied at each pruning. No advantage has been obtained by burying the prunings.

Plot 141, prunings heaped, gave 608 lb. per annum in 1914 and 1915.

Plot 142, Singlo jat prunings heaped gave 710 lb. per annum in 1914 and 1915.

Plot 143, singlo jat prunings buried gave 595 lb. per annum in 1914 and 1915.

Plot 155 manured with cattle manure in 1909 and 1911 continued to yield well until 1915 showing the lasting effect of this kind of manure. This year showed a considerable falling off compared with last pruning year viz. 549 lb. against 854 lb., but the decrease is partly due to several bushes having been killed out by the Cora weed, *Cyperus rotundus*. Varieties of sweet potato have been planted through the tea on the affected areas, but the effect is only temporary, the weed re-appearing as soon as the cover plant is removed.

A new series of experiments on manuring and the effect of different methods of plucking are being begun in 1916.

COCONUT EXPERIMENTS.

The manurial experiments with old coconuts begun in 1911 have not been completed and the final detailed results will be issued as a bulletin. The general result of the manuring has demonstrated that such old coconuts (50 years and over), which represent an enormous acreage of the small native holdings in Ceylon, can be improved in vigour and yield by cultivation and manuring. The average yield per palm has steadily increased from 26·7 nuts in 1911, to 42·1 nuts in 1914 and 42·7 nuts in 1915, an increase of 60 per cent. No manure was applied in 1915 on account of war economy. The application of a complete general mixture gave the largest number of nuts, raising the yield from 29 nuts per palm to 57 nuts or 96·5 per cent., at a cost of Rs. 25 per acre. The application of a soluble mixture every six months gave even a larger increase from 23·4 nuts to 54 nuts per palm or 131%, at a cost of about Rs. 25 per acre per annum.

The most remunerative return was obtained by digging in or mulching round the palms with sensitive plant (*Mimosa pudica*) and other weeds and applying a mixture of Basic slag and Kainit in equal parts at 400 lb. per acre. The mixture cost about Rs. 11 per acre. The yield per palm increased by this treatment from 30·7 nuts in 1911 to 55 nuts in 1914 and 56 nuts in 1915.

A feature in the manuring results is the increased power of the palms to retain the young nuts, although 44% are still lost annually. Before 1914 the proportion of immature to mature nuts was always greater, but since 1913 a steadily increasing proportion of nuts have matured, viz., 37·5% in 1913, 51% in 1914 and 56% in 1915.

The number of nuts required for a candy of copra (560 lb.) is still much higher than in the low country, the average being 1613 nuts.

The general appearance of the palms has much improved, the foliage being of a richer dark green and the fronds heavier. Several manurial experiments with young coconuts are being carried out, but results are not yet available for publication.

Visits were made to Chilaw and Kurunegala coconut plots and the results of the year's working tabulated for a future bulletin. One or two modifications of the plots at Chilaw have been to more completely demonstrate the value of dry farming in a climate liable to rather severe droughts in February and August.

The chemical work included several analyses of soils, manures, oils, etc., also investigations into the acidity of soils.

Analyses of three varieties of groundnuts grown at Ganoruwa showed that the Ceylon variety contained the largest percentage of oil, and being the heaviest yielder is therefore the most remunerative.

The calculated yield of nuts, oil and cake, the latter containing about 6·2 % oil, from the three varieties would be:—

Variety.		Lb. per acre.	Lb. oil per acre.	Cake residue per acre. lb.
Spanish	...	367·5	161	206·5
Virginia Bunch	...	302·5	121	181·5
Ceylon	...	1,630·0	735	895·0

The nuts vary in size, 1lb. weight containing 762 Spanish, 445 Virginia and 685 Ceylon nuts, the latter having rather thicker skins, the proportion of skin and kernel being 3·25 and 96·75 % respectively.

Four varieties of sweet potato, which grow luxuriantly at Ganoruwa were analysed for starch and sugar content. The yellow and red varieties were similar in composition containing an average of 1·45 % dextrose and 16·45 % of starch, calculated on the fresh tuber. A pink variety contained 1·65 % dextrose and only 13·44 % of starch, while a pale tuber had 19·5 % starch and 1·2 % dextrose.

The latter is very similar in composition to the ordinary potato which is largely employed in Europe for the manufacture of starch and alcohol.

The yields of these tubers per acre are being recorded, but a good crop is said to be from 4 to 5 tons per acre.

Owing to the demand for Thymol as an antiseptic an experiment was made with the growth of Ajowan seed (*Carum copticum*) obtained from India. The plants grew freely and were of two kinds, yellow and white, the seeds of which were collected separately for further sowing. The seed of the white variety yielded on distillation 2·2 % of oil, containing 60 % of Thymol.

Analyses of the mature bark from a Para tree free from sand gave 0·9 % of nitrogen, 5·25 % of ash, the latter containing 41·8 % of lime, 9·30 % of potash and 3·2 % of phosphoric acid.

The results of pot experiments on the growth of rubber in pure silver sand with various plant foods added were not very satisfactory tending more to show the great difference in individual plants rather than the effect of any particular constituent.

The experiments are being repeated with rubber, tea and cocoa and promise better results during 1916.

M. KELWAY BAMBER.

ARECANUT CULTIVATION IN MALABAR.

The arecanut palm is distributed all over Malabar, but nowhere is it so extensively cultivated as in the red soil tract of the Ponnani Taluq where a total area of 10,577 acres was recorded in Fasli 1324. The high lying paddy fields and valleys of hills are being converted into areca topes every year and the cultivation is therefore on the increase.

It is propagated by seed. Ripe nuts are gathered from old trees and are kept in shade for a few days before sowing. Seed beds are dug well, a fine tilth is obtained and powdered cowdung and ashes are applied. The nuts are buried a foot apart and watered on alternate days. The germination takes place in 45 days. The seed beds must be clean from weeds. The seedlings are fit for transplanting when 2 to 3 years old.

The land selected for the plantation is cleared of all vegetation. Holes 2¼ ft. deep and 2¼ ft. by 2¼ ft. are dug at intervals of 6 ft. to 8 ft. some time before the North-East monsoon ceases and the land gets hard. During the hot weather the holes are partially filled with rubbish, which is burnt to ashes. Seedlings are planted in April-May, June-July or November. The June-July planting is more universal. When the plants grow to 25 years old second planting is done in the interspaces to keep the plantation going.

This palm readily responds to liberal manuring and the produce shows the care bestowed on it. No initial manuring is given. Some cultivators manure their gardens on three occasions i.e. in July, November and March The second manuring is very often neglected. A mixture of green leaves, cowdung and ashes is the manure used, the quantity increasing with the age of the plantation. The difficulty of manuring is increasing as the supply of green leaves has been getting less and less. This defect may be remedied by raising a green manure crop before the South-West monsoon is in full swing. This serves an additional purpose of keeping down weeds also which spring up luxuriantly in the season.

Irrigation is an important item. It is expensive and laborious. It begins in December and is continued until the monsoon becomes regular. Irregularity in irrigation results in the shedding of nuts. The usual water-lifts in vogue are the picotta and the mhote. The former is used in small gardens of 500 trees or less and in big gardens the latter is in use.

The picotta is so fitted that 2 buckets can be worked at the same time. A bucket holds about 6 gallons of water. Two men for lifting, one boy or girl for guiding water are necessary and the work is done on contract at Rs. 5/- per mensem.

It is a very common practice to grow plantains between young arecanuts to provide shade. This crop gives an earlier intermediate return which helps in keeping down to some extent the cost of cultivation of the areca trees until they are able to pay. Also betel vine is trained to grow on the trunk of this palm and this is an extra source of profit to the owner.

The arecanut begins to bear in the seventh year of its planting and only in the tenth year it comes to full bearing stage. It bears for 45 years and may live 80 years or more. It flowers in February and in every month till July a flower spathe is thrown out. There will be 4 to 5 bunches of nuts on each palm and in a few cases 7 bunches even. A good bunch contains up to 400 nuts the average being 75 to 100 nuts. Thus a tree yields 300 to 400 nuts annually. The first picking commences in June, a few nuts being ready. Later the nuts increase in number with every picking. The bulk of the harvest takes place in October. Harvesting wages are paid in kind 2 nuts being given for every bunch plucked. An able-bodied cooly will climb 100 trees in the busy season and earn about 400 nuts valued at 8 to 12 as. In a

pretty old plantation harvesting is easier than in a young plantation that has just begun to yield as the climber in the former case can reach tree after tree by swinging.

The garden owner husks the nuts before he takes the produce to a market. A cooly gets 4 to 5 palms (1 palm=15 Re. weight) for every maund of husked nuts. About 1,500 shelled nuts weigh a local maund of 37½ lb. A similar weight of dry nuts sells at Rs. 10/-. 3 maunds green are reckoned as equal to 1 maund dry. The process of preparing the nuts is done by merchants.

The cultivation charges for 500 trees for the 1st year will come to Rs. 90/- and later the amount will not exceed Rs. 60/-. Investment in the areca plantation is profitable as in normal years a block of 500 trees yields an annual profit of Rs. 250—AGRICULTURAL STUDENTS' JOURNAL (MADRAS).

EXPERIMENT STATIONS AND RESEARCH.

Thirty years ago all research in the United States was relatively restricted in scope and amount, and this country had, in fact, hardly caught its spirit or import. Science itself still seemed to be a purely academic affair which rarely bore any obvious relation to the practical world, and research was deemed a sort of intellectual exercise for a special class. The rigid scholastic conception of pure science as contrasted with applied science was widely prevalent. The ideal investigator was thought of as a kind of crusader who enlisted with almost religious fervour under the banner of truth, with the battle cry of truth for truth's sake and science for science's sake ; but too often truth and science were regarded as purely abstractions in the realm of ideas with no necessary connection with the world of concrete things.

Research gained a solid footing earliest in endowed colleges, universities, and institutions established for investigation in special lines, but the development there was generally quite limited. It was largely concerned with abstract propositions, and its activities were regarded with curiosity rather than with comprehension or understanding. Least of all was it looked for at the agricultural colleges, which were expected to interest and instruct their farmer constituents through their model farms and superior live stock, and were thought of by other classes of colleges as being distinctly elementary and vocational rather than for the broad advancement of learning.

How remarkable, therefore, that these same agricultural institutions should in so short a period have become great centres of investigation and in a measure set apace for it which has been reflected in many other classes of institutions. It is probably not too much to say that they have been the greatest single agency for stimulating research in its varied branches by force of their example and success, their closeness to the people, and the confidence and understanding which they have won for experimental enquiry. Agricultural investigation has shown, as no other class of investigation had previously shown, the direct practical relations of such activity to every-day life and to human welfare, and has popularized it in the mind of the people. This interest has been extended to the various departments of science in general.

With this widespread acceptance and approval of the stations by the general public has come an increasing realization of their achievements and opportunities by the scientific world. The impressions formerly more or less current in scientific circles that agricultural investigation was hardly comparable in quality with the research carried on at endowed universities and similar institutions is rapidly becoming dispelled. To-day the stations are

not only recognized as important and valued factors in the advancement of knowledge and its application to the improvement of mankind, but as possessing many and unique advantages as fields of opportunity for the man with high scientific attainments and the desire to carry on research.

Conditions have radically altered since the days when station positions were, as a class, too often thought to offer little of promise to such a man. The station staffs have come to include some of the best-trained men in the country. In biology, chemistry, physics, and other sciences, vacancies in the station ranks are being sought by candidates of high qualifications as comparable with, and in some respects even preferable to, opportunities open to them elsewhere. It may be of interest to note briefly some of the reasons for this change of attitude and some of the considerations which now render these positions so attractive.

In the early days of the experiment stations their resources were small and their outlook for development uncertain. They themselves were looked upon as experiments and had first of all to demonstrate their right to existence. A full-fledged system of purely research institutions was impossible under these conditions, and a period of transition was inevitable.

Little by little most of the disadvantages formerly surrounding the stations have been overcome. Increased popular appreciation has brought with it enlarged resources, and these have made possible more adequate equipment, better trained assistants, closer differentiation in both subject matter and kind of activity, relief from a variety of distracting duties, and opportunity for concentration upon problems worthy of study. Fortunate, indeed, is the endowed university or similar institution now possessing superior advantages along these lines.

Station work has been organised on a more logical basis than formerly, the subject matter has been subdivided, and the services of specialists extensively employed. Instead of an undifferentiated department of horticulture we may now find plant breeders, physiological botanists, pomologists, and the like. Agronomy has resolved into soil physics, chemistry, bacteriology, farm crops, etc. At the same time the boundaries between the general sciences have been broken down as the inter-relations of the various branches have become apparent. The physicist has been enlisted in soil investigations, the biologist in studies of the laws of inheritance in plants and animals, the chemist in determining the function of new groups of food constituents, the engineer in the provision and employment of water, etc.

Marked progress has been made in bringing about an enlarged public understanding of the methods of research. It is now generally recognized that the solution of most agricultural problems requires time, and that it cannot be safely hurried. We less often hear impatience expressed at a failure to solve a problem in a few months. The general public has better learned to trust the judgment and ability of the station worker, and to await with patience and confidence the completion of his efforts.

More attractive, however, in the eyes of the true investigator than fine laboratories, or otherwise congenial environment is the opportunity afforded for productive research. In this respect the stations now offer an especially attractive field. Where to such an extent as in agriculture can be found problems of such varied complexity and immediate and wide application? Agriculture in its present stage involves a contest with the elements and with industrial and economic conditions. Its problems are ready-made and pressing, not to be postponed without loss and sometimes hardship. Millions of dollars and the prosperity of whole sections of our country may be at stake in an investigation of a new disease of plants or animals, the utilization of a bye-product, or the more intelligent use of the soil. The very size and indispensability of the industry and the difficult character of many of the

problems involved in it furnish an unusual inspiration. The subject taxes the ingenuity, the scientific ability, and the acumen of the investigator and gives as large a range for his efforts as any known field of inquiry. Modern agriculture is a harnessing, control, and utilization of the elements and phenomena which operate in accordance with the scientific and economic laws. In its form and content at any stage it exemplifies in a significant degree the status of man's knowledge and mastery of natural forces.

In the early days the demand for immediate practical results was often accompanied with the insistence, even by boards of control and administrative officers, that the experimenters should be chosen primarily because of their practical knowledge of farming or horticulture. But now it is seen that investigators without scientific training are not likely to obtain anything more than superficial or empirical results. Hence the standard of scientific training for station workers is steadily rising. Men with elaborate and advanced training along scientific lines are in demand for the specialized positions now open in the stations. Young men, therefore, have a strong incentive to prepare themselves thoroughly for research in agriculture.

The wide and rapid spread of extension work in agriculture, until it now covers practically all phases of agriculture throughout the United States, is already beginning to increase the opportunities of well-trained men to engage in agricultural research. The large number of well-paid positions opening in the extension work is attracting from the ranks of station workers those who are most interested in popular phases of agricultural work. Thus the opportunity is often given to put in their place better trained men with a more serious interest in research. The extension workers are also creating a broader demand for more complete investigations, the results of which can be used in demonstrations among the farmers or in answering inquiries pressed home upon the extension men now living in close contact with the farmers. As time goes on extension work will inevitably become more highly specialized and the demand for new knowledge to be put to practical use will grow apace. With such a backing of widespread interest in the improvement of agricultural practice based on the results of scientific research, there is every reason to believe that the opportunities for the stations to strengthen and enlarge their researches will steadily grow.

All these facts are becoming widely known and appreciated in the scientific world. They present considerations which count for much among investigators, and explain the prestige which the stations are acquiring as desirable fields of opportunity. It is fortunate that the stations are thus coming into their rightful position, for the unsolved problems in American agriculture are many and intricate and their importance justifies the enlistment of the services of the best-trained scientists of the land in their solution.—EXPT. STN. REC.

AGRICULTURE IN INDIA.

SHORTAGE OF OFFICIALS.

At the first meeting of the autumn session of the Imperial Legislative Council, HIS EXCELLENCY THE VICEROY said that the activities of the departments administered by the Department of Revenue and Agriculture had been restricted both by the need for economy and the shortage of officials. Not only had the services of a considerable number of officers been placed at the disposal of the military authorities, but it was at present difficult to obtain suitable recruits, especially for the Forest and Agricultural Departments. They had lately, however, been able to secure the services of two experts from Home to conduct special investigations. One of these was studying

the problem of reviving the trade in natural indigo. If he could devise a means of standardising the natural product in a form which would enable it to compete with the German synthetic dye, it was to be hoped that the planting interest will adopt some co-operative system of manufacture and marketing, and thus place this once profitable industry on a sound basis for the future. A tanning expert had also recently arrived with a small extract plant and was engaged on an investigation of the tanning materials yielded by various forests in India, with a view to preparing tanning extracts for trial on a commercial basis. If his researches were successful, not only would the Forest Department obtain a new source of income, but the tanning industry might be expected to develop on a large scale and to produce good leather from the enormous quantities of hides at present exported from India in a raw condition.

SILK INDUSTRY.

DR. LEFROY'S enquiries into the silk industry were interrupted by a visit to Mesopotamia, where he did valuable work in organising measures for the destruction of flies and vermin, but he had now returned and resumed his investigations. It was hoped that they would result in a considerable revival of this historic industry. Without forestalling his report, H. E. thought he might say that he would show that large parts of the country, especially the submontane tracts, were suitable for the production of the silkworm, which cannot thrive in the arid heat of the plains. It was equally important to know the areas which were unsuitable so that efforts to develop the industry might be concentrated in those tracts which offered the best prospect of success. The HON. MR. HILL explained at the discussion of the financial statement last March that the present period of comparative inactivity was being utilised for the preparation of schemes, especially in connection with agriculture, for development when more favourable conditions recur. It was H. E's hope that these schemes would bear bountiful fruit during his term of office.

VASTLY INCREASED YIELD.

The success of the researches at Pusa in selecting improved varieties of various crops, especially of wheat, had demonstrated the possibility of getting a vastly increased yield from indigenous species. There was room for many more workers in this field, and in course of time every large Province should have a competent staff to work out local problems. There was equal room for expansion in the work of demonstrating the results of these researches. The Indian cultivator had shown himself quite ready to adopt improved methods as soon as he was convinced of their utility, and H. E. looked forward to a time when demonstration farms would be spread all over the country, bringing the practical results of scientific research within the reach of the agricultural masses. The improvement of agriculture, besides bringing prosperity and content to the majority of the population of India, would provide a worthy career for the young educated Indian who desired to serve his country but did not always find the best way of doing it.

AGRICULTURAL EDUCATION.

The recommendations of the Conference on Agricultural Education, over which the HON. MR. HILL presided last February, had been considered by the Government and had recently been referred for the opinions of the local Governments. The Conference dealt, among other matters, with the question of reforming the system of education in our agricultural colleges. One of the chief needs of these colleges was to attract suitable students. The development of agricultural farms should tend to effect this object, but more farms could only be opened as men became available to manage them. Agricultural education and development were thus interdependent. H. E. wished from his personal experience in Australia, to lay stress on this. Agricultural colleges and demonstration farms had played a great part in the

development of the agricultural industry in that country, and though the farming community was notoriously conservative, it had, through these means, been awakened to the possibilities opened out by science. H. E. wished to impress this further fact on Indian parents when they were planning the future of their sons. They might well pause to consider whether, instead of sending them to join the over-stocked market of the legal and literary professions, it would not be better to turn their attention to the possibilities of employment in scientific agriculture. As the department expended, it would afford greater opportunities of advancement and the man who elected this service might work for himself and at the same time contribute to the prosperity of his country.—C. O.

TREES AS WATER RESERVES.

The following paper by I. M. SIM, Honours Diploma in Forestry, on Forest Conservation, published in the SOUTH AFRICAN FARMERS' ADVOCATE in October, is another valuable addition to the scientific literature on Forestry, which subject is to-day engaging the earnest attention of various Governments the world over. Such papers are of great value to us in Queensland as well as to European and to the United States Governments. We have frequently advocated the conservation of existing forests as well as the reafforestation of denuded areas in our State, in the interests not only of posterity but of our present day agriculturists and pastoralists. The denudation of our timbered areas—especially scrub lands, for agricultural purposes, and the consequent diminution of rainfall in such areas, has been the theme of many of our articles on Forestry in this Journal, and it has been pointed out how this serious result of clearing lands for agricultural purposes has proved to be injurious to those settlers who, for a time, benefited by the removal of the timber. This paper, showing, as it does, that the predecessors of the present inhabitants of South Africa were responsible for the treeless dry areas of that country, should surely be considered as a warning in time to the States of the Commonwealth of Australia.

MR. SIM here shows how to combat certain destructive processes, how increased precipitation may be induced, and run-off minimised in the following words:—

The inhabitants of South Africa have to ask themselves in how far they and their predecessors are responsible for the fact that South Africa is for the most part a treeless and dry country. We have abundant proof that it was not always so, both in the naming of places—now semi-desert—by the early settlers and by the records left by the missionaries and writers of the early days of South Africa. For instance, the naming of places such as the Bloemfontein and Wildfontein show that, at the time these names were given, the flora must have been very different from that of to-day. Such examples of names, denoting a plenty of water and of flora are to be found throughout what are now some of the driest districts of South Africa; in the Cape Karroo, in the Free State, and in Bechuanaland.

In the archives of the Cape are to be found numerous "placaats," prohibiting the felling of timber on the Cape Flats, around Paarl and Worcester and even further north towards Saldanha Bay. DR. MOFFATT, that veteran missionary of Griqualand, describes the forest existing even in his time near what is now Kimberley. Rains then were plentiful and reliable. To-day all is different. The herbage has been largely destroyed, the ground surface is parched, and, as a consequence, the rains are less in volume and are irregular. When they do come, owing to the bare-ground surface and the streambeds being unimpeded by herbage, they flood the rivers and run to waste.

PLANTS AND PRECIPITATION.

Now it has been proved that there is an intimate connection between the plant-life of an area and the precipitation and retentive power of that area. First, as regards the precipitation on an area, it is found that rainclouds are either attracted or repelled by the condition of the ground-surface. This is chiefly due to the amount of heat radiated by the ground. Clouds, or in their initial condition rather air currents laden with moisture, strike an area. Whether or not the moisture in the air is deposited depends on the heat of the ground struck. If this is warm—at any rate, warmer than the air-current —the result is the expansion of the air forming the current, and in the expanded condition it can hold more vapour and therefore will deposit none of what it originally had.

But, on the other hand, if the surface struck is cooler than the air-current, the result is the reverse. The volume of air is reduced and in proportion its water-carrying capacity is diminished. The vapour in the air-current is condensed and it primarily assumes the form of a visible cloud; it is then precipitated as mists and gentle rains. The problem at this stage then is to get the ground surface into the cool condition which induces gentle precipitation.

There are only two means by which this can be done; firstly, by having the surface so shaded by herbage as to be always cooler than the surrounding air, and secondly by having it, if bare, in such a condition that it is able to absorb and conserve moisture when precipitated and to evaporate it slowly but continuously when no precipitation is taking place: Ploughed land is an example of this condition.

The first of these means—the ground surface so shaded as to be constantly cooler than the air coming in contact with it—is the means devised by nature for inducing and retaining regular precipitation.

Naturally the country throughout even the present driest parts of South Africa had the ground-surface covered with vegetation. Forest was much more plentiful than it is to-day and savannah (single trees scattered amongst grass) and grass-land existed where there were no forest. The result was gentle and frequent rains. But this was a condition man could not permit to exist. The forests have been cut down, light let in and water drained off, and, as a consequence, the temperature of the forest areas has risen. The trees on the savannah areas (our thornvelds) have been cut for firewood and the grass has been burned until areas, once useful, productive thornveld, have been turned into korroo-veld with a depleted rainfall.

But so far I have only dealt with the precipitation of rain. For the air-currents to precipitate that rain they must receive the moisture from somewhere. A large percentage is, of course, obtained from the sea, but the final saturation moisture is received from the land. To give off this moisture the ground must first have had it to give. Now the absorbing power of ground depends on the surface and on the free or restricted flow of water in the streambeds. It is in this connection that the greatest evil of veld-burning bears fruit. Fires, since the time of the first sighting of South Africa by the Portuguese navigators, have been of annual occurrence. The result, apart from the destruction of the herbage, has been the rendering of the ground-surface into a condition in which water cannot be absorbed.

To briefly deal with this question of the power of absorption of the ground being destroyed by fire, it must be remembered that the natural herbage performs a double function. The leaves shade the ground and by thus keeping it cool tend to induce the precipitation of rain, and the roots and dead leaves, mixed with the soil, form a layer of spongy humus which absorbs deposited moisture and prevents too rapid evaporation.

But the annual grass fires not only temporarily destroy the foliage and even the veld—this is a separate subject which cannot be gone into here—

but they burn out and destroy this spongy layer of humus and bake the ground-surface, rendering it practically impervious to rain. From it deposited moisture rushes off to the nearest spruit or river. Every Kaffir and sheep track acting as a drain, the result is obvious.

The next point is to deal with the streams themselves. These, in the first instance, were all running, supplied by the stores of water absorbed by the spongy layer of humus. But, when this humus was destroyed the supply of water was reduced. If this reduced supply of water was to continue to flow it was at least necessary for the evaporation to be reduced to a minimum. Instead of this, grass fires destroyed the scrub and other herbage along the banks and exposed the banks and increased the evaporation; for, it must be realised, the evaporation from an open stream with exposed banks is several times greater than that from a stream with trees, scrub, and undergrowth along its borders.

Not only is the evaporation increased by the destruction of the stream-bank herbage, but a second evil is brought about. With herbage on the banks a certain amount of resistance is offered to the flood waters, allowing these waters to soak in and lessen their velocity. With unimpeded banks, the water runs to waste too rapidly for any soakage to take place or for any good to be wrought to the country.

Now all these desiccating processes—and many others which it is impossible to deal with in detail in such an article as this—have been brought about by the destruction of herbage. The question that arises then, is how these destructive processes can be combated, increased precipitation induced, and the run-off minimised. There is only one method and that is by proper and suitable reclothing with herbage the bared areas. The first step should be the absolute prohibition of grassfires, for with them as an annual menace, no permanent good can be brought about. Australia, the United States, and other countries have imposed the severest penalties on grass-burning. Once this is put down, the greatest cause of desiccation in South Africa would be abolished. Nature would slowly tend to reassert herself and to improve the water supply. But we cannot afford to wait for the natural processes, we must assist nature and this assistance must take the form of suitable reafforestation.

REAFFORESTATION.

What is suitable reafforestation? The three primary necessities are all I have room to touch on here. They are—

1. Entire conservation (not biassed by political aims) of our indigenous forests.

2. Reafforestation of the mountains—since they are first struck by the air-currents containing moisture—with suitable humus-producing trees, such as pines and cypresses.

Entire protection, and, if possible, reafforestation of our stream-banks with suitable trees and shrubs. These must be species with a minimum of evaporation, and in this respect our indigenous shrub, Buddlica (Zalichout), Rhus, Combreyhim, Cunonia, Enythrima and many others are of the first value.

Through the limitations of space, I am only able to touch the fringe of a great subject in this article, but the outlines are sufficient to show how South Africa, the land loved by all her inhabitants, is suffering by desiccation which can be prevented. It is our duty both individually and collectively to convert the present processes of deterioration into processes of the greatest improvement for our land.—QUEENSLAND AGRICULTURAL JOURNAL.

HISTORY & PROGRESS OF THE CO-OPERATIVE CREDIT MOVEMENT IN CEYLON.

To the Agricultural Society must be accorded the credit of having taken the initiative in the question of Co-operative Credit Societies in Ceylon, and it is a striking coincidence that the date of the establishment of this society synchronises with that of the passing of the Indian Co-operative Credit Societies Act, viz., 1904. The organising Vice-President (DR. WILLIS), the Secretaries (MESSRS. DENHAM and DRIEBERG) and several enthusiastic members interested themselves in obtaining the necessary information from India and Europe and considering the application of measures adopted elsewhere to Ceylon. The first local society was established in the year 1906 in Dumbara (Kandy District) on the lines of Indian Societies. This society had for its secretary MR. RASANAYAGAM, an enthusiastic officer in Government service who, with the support of DUNUWILA DISAWA and a few others, made the society such a success as to win the commendation of HIS EXCELLENCY THE GOVERNOR.

The keen interest taken in the movement by SIR HENRY MCCALLUM resulted in the subject being discussed at more than one "Durbar" of the native Chiefs of the Kandyan and Low-Country Provinces.

In 1909 a Committee was appointed by the GOVERNOR to consider and report "on the whole question of Agricultural Banks" in Ceylon. This Committee after much deliberation submitted their report to Government (Sessional paper 8 of 1910) the following year.

It was a happy augury that the first Secretary of the Ceylon Agricultural Society was appointed Secretary of this Commission and the present Secretary gave evidence before it.

In the year 1911 an Ordinance was passed by the Legislature (No. 7 of 1911) "to provide the constitution and control of Co-operative Credit Societies in Ceylon" and the then Registrar-General (SIR P. ARUNACHALAM) was appointed the Registrar under the Co-operative Credit Societies Act. The local Ordinance was thus enacted seven years after the Indian act was passed. But though the ordinance was passed and a Registrar appointed no advantage was taken of its provisions for some time.

By this time the Dumbara society began to interest itself more than ever in the Co-operative movement by helping to establish a few societies. It was, however, realized that for sustained progress a definite policy and a special personal campaign were essential.

In the year 1913 MR. LYNE, the late Director of Agriculture, submitted a scheme to Government with the result that the present staff was appointed, the Director himself as Registrar.

Thus a definite stage of development was arrived at and a number of societies have been since established in various parts of the Island.

As is well-known, these societies are meant for cultivators and others of limited means who are generally found resident in the villages. But the difficulty was to induce these people to recognise their benefits. The more prosperous land owner did not as was expected come forward to help his less fortunate brothers by supporting a movement calculated to benefit them. It was therefore necessary to seek the assistance of rural officials. This too led to misapprehension. People doubted the good intentions of the officials. It was thus after much trouble that the masses were satisfied of the benefit of co-operation and began to think over the advice of the Registrar and his Secretary and their own Headmen,

In some cases, societies started with the assistance of headmen gradually slackened off for want of sustained interest. This was even worse than if they had never been started, and only went to confirm a suspicion that the movement was not adapted to local conditions. Happily, however, there were also some societies which were worked successfully and contributed largely to win the confidence of the people.

In the year 1914 a Conference of Co-operative Societies was held under the patronage of the then Governor SIR ROBERT CHALMERS at the King's Pavilion, Kandy. This gave a decided fillip to the movement and many were convinced of the value and importance of the subject. It did more than this; it laid the foundation of a "Local Loan and Development Fund" for the operation of which an Ordinance was passed at a recent meeting of the Legislative Council.

From the headmen the interest in the movement spread to leaders of communities, professional men, landed gentry, and ministers of religion, and important bodies such as the Ceylon Social Service League; and the outlook is at present very encouraging.

There are also signs of the movement being taken up by the villagers themselves without any extraneous aid.

While rural societies are looking after the villager and his needs, town societies are being formed and worked such as the Plumbago Employees' Society organised under the auspices of the Ceylon Social Service League to look after the working classes in the towns.

No measure is likely to succeed which does not receive the sanction and co-operation of leaders, official and unofficial. At present very valuable aid is being lent by the headmen of the Island.

The Adikaripattu and Kumbukke Pattu societies in the Rayigam Korale of the Kalutara District; the Minuwangoda society in the Alutkuru Korale North of the Negombo District; the Medagama and Makulla societies in the Wellassa District of the Uva Province, and the Walapane Society in the Nuwara Eliya District have succeeded mainly through the efforts of the Chief Headmen. These and very many others are working on the right lines and are bound to do an incalculable amount of good. In a remote place like Wellassa the three societies worked by the Ratemahatmaya have over 1,000 members. There are several societies in the Southern Province under similar good influence. Societies worked with the help of private individuals are doing excellent work too. For instance, the Kalapaluwawa society in the Colombo District and Udupiddi society in the Jaffna District are both organised and worked by such and are doing an immense amount of good to the villagers of the localities.

It is much to be regretted that the movement has not progressed as satisfactorily as it should have done in the Kandy District where it first started. The few societies established in this district do not show satisfactory progress. There is only one society in the Kurunegala District (Hiriyala Hat Pattu worked by the Ratemahatmaya) where I regret to note that no progress has been made.

The work of the Co-operative Credit Societies is not only concerned with agriculture proper but also with industrial work which Government is at present greatly interested in. For example the Jaffna Industrial Co-operative Society operates chiefly among workers in gold, silver, brass and copper and has succeeded in winning the confidence of the people. The Government Agent of the Northern Province (MR. B. HORSBURGH) recently presided at one of the meetings and addressed in the vernacular about co-operation.

A personal interest of this kind on the part of the Government Agents of the other Provinces is pleaded for; as it is believed that the movement will then make great strides.

In the case of some societies, progress in certain directions has been truly phenomenal. The distribution of manure for paddy fields has been vigorously taken in hand by more than one society and 40 to 50 tons are being handled each season. By this means manure of good quality has been made available at cost price and easy terms arranged for payment at the end of the harvest.

Other societies have purchased agricultural implements from large dealers at wholesale rates and sold at cost price.

Others again have taken up the introduction of seed of good strain and of new varieties, e.g., Molagu Samba paddy; and still others have gone in for transplanting paddy while one or two others are making arrangements to start experimental gardens.

Assistance has also been given by wealthy land owners by promises of grants of money, (e.g., MUDALIYAR RAJAPAKSE of Negombo) on loan at low interest and allowing the use of fields for experiments. The Hataraliadde society conducted experiments in transplanting paddy on land kindly placed at its disposal by MR. J. C. RATWATTE of Kandy.

One or two of the Jaffna societies propose to purchase pumps for raising water from wells.

There have, of course, been cases of failures such as the societies started at Batticaloa, and Ratnapura; discredit for which is not so much to be attributed to the people as to those who are acknowledged to be their leaders.

The following particulars of the transactions of a few working societies will indicate at a glance the work done by them during the year 1915-1916.

(1) *Kalapaluwawa Society.*

Six loans for paddy cultivation	...	Rs. 160 00
Four for growing vegetables	...	85 00
Six for petty trading	...	180 00
Seven for building and repairing houses	...	220 00
Five for buying carts and bulls for earning a livelihood		165 00
Five for redeeming mortgages	...	270 00
		Rs. 1,080 00

This society deals with one village and the number of members is 121. Paid up capital Rs. 687·75. Government loan Rs. 250. Reserve Fund Rs. 47·04.

(2) *Kumbukke Pattu Society.*

This society lent Rs. 1,165 to 26 members within the year.

Eight loans for cultivation of lands
Six for leasing and improving lands.
Five for petty trading.
Three for buying timber and tools for carpentry work.
One for buying requisites for a printing machine.
Two for brass work to smiths.
One for buying an oil mill (coconut chekku for copra)

This society has 86 members. Paid up capital is Rs. 1,109. Reserve Fund Rs. 75·75.

Six tons of manure for paddy were received during the *yala* season and sold among members at cost price.

(3) *Makulla Society.*

This society has 513 members. Paid up capital Rs. 644. Reserve fund Rs. 15·72. The amount of loans given and outstanding at the close of the year is Rs. 400.

Forty loans for agricultural purpose Rs. 400.

(4) *Minuwangoda Society.*

One loan for cultivation of lands	...	Rs. 100 00
Nine loans for manuring lands	...	1,075 00
Two for repaying old debts	...	120 00
Eight for petty trading	...	705 00
Two for buying lands	...	200 00
		Rs. 2,200 00

There are 351 members. The paid up capital is Rs. 2,114. Reserve fund Rs. 147·83. This society is largely dealing in manures for paddy and coconuts.

From the above cases it will be seen how a society can serve its members. Considering the success of the large majority, the failure of the few can only mean apathy and indifference on the part of those who have failed to do their duty by their neighbours.

N. WICKRAMARATNE.

THE ADJUSTMENT OF COCONUT CULTIVATION IN THE KURUNEGALA DISTRICT.

HOW PEASANTS SHOULD BE ENCOURAGED.

The operations connected with the development of land in this district under coconut are modern history. Except a few groves in the vicinity of dwelling houses, no regular plantations existed fifty years ago.

Capitalists from the maritime border, seeking fresh fields of enterprise, gradually migrated towards Kurunegala. Large extents were brought under cultivation, and the thoughts of local residents were directed to the coconut enterprise as an investment worth taking up.

A journey through the district will however disclose a startling fact to the intelligent inquirer. He will find that in most cases the coconut industry is in the hands of the larger proprietors, and that the peasant has not yet adjusted himself to the changing conditions of the age.

Several problems arose immediately after the opening up of the district.

The peasant realized that there was money in land. Never possessing the capital necessary for the purpose, he took the easiest route towards wealth, and in a short while had parted with every spare acre of highland he owned.

By this method, the homogeneity of the old-time settlement was considerably disturbed, and people from all parts of the island commenced to flow in, while the villager who never understood the use of money was soon left with nothing of what he had made by selling his land.

In course of time the villager when not engaged in cultivating paddy began to seek employment on the plantations in his neighbourhood and, where Tamil labour is not available, hires his services at a daily wage, somewhat higher than his neighbours from the coast generally demand.

Imprudent, shiftless, and unthrifty, the peasant who was once comfortable, and able to satisfy his modest needs, has now developed into a hired labourer, with no ambition beyond that of living for the day.

This picture of the peasant of to-day is not over-drawn. Many landowners of similar standing to myself will I think confirm its essential details.

No one interested in the country will be content to leave the matter where it stands.

Ceylon in ancient times was one great settlement of peasant proprietors, and it is meet that its people should be offered every facility for recovering their original prosperity on sound lines and by well-thought-out methods.

It is obvious that the higher standard of living, and the necessity for maintaining a contented and settled peasant population in the country—without which no country can rightly be considered prosperous—demand the adoption of early measures for interesting the village community in the exploitation of the coconut enterprise as a business proposition.

It has been proved by nearly half a century of practical experience that the coconut palm, if intelligently cultivated, may be expected to benefit the peasant almost as much as it does the capitalist.

The two essentials in this connection are:

(1) Land.
(2) Capital.

Most of us who are indigenous to the country, when speaking of land, appear to recognise only one form of tenure, viz., the freehold: but this form has I think been mainly responsible for the existence of absentee landlords, and large areas owned by them are still lying undeveloped. The only person who benefited by this form of tenure was the capitalist.

It has been announced that the Government after much thought proposes to meet the need of the poorer class by inaugurating a system of leases. There are many who will at first look askance at this proposal, but it has long been felt that if the peasant is to be encouraged to settle on the land under the changing conditions of to-day, this new system will prove the best solution to his difficulties.

Capital will always be obtainable within the settlement itself, provided advantage is taken of the provisions of the Co-operative Credit Societies Ordinance.

Land and capital being available, sympathetic encouragement and persistent energy in pursuing a settled policy should in a generation convert a restless peasantry into a self-respecting and productive community.

T. B. L. MOONEMALE.

Kurunegala, 3rd October, 1916.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Soccotrine cwt.	Fair to fine	100/ a 110/
Zanzibar & Hepatic ,,	Common to good	60/ a 100.
ARROWROOT (Natal) lb.	Fair to fine	3½d a 4d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 17/6
East Indian bleached ,,	Fair to good	£8 10. a £8 15/
,, unbleached ,,	Dark to good genuine	£6 a £6 12 6
Madagascar ,,	Dark to good palish	£7 a £7 15
CAMPHOR, Japan lb.	Refined	2 4½ a 2/6
China cwt.	Fair average quality	155/ nom.
CARDAMOMS, Tuticorin per lb	Good to fine bold	3/6 a 4/6
	Middling lean	2/ a 2/9
Malabar, Tellicherry ,,	Good to fine bold	3/6 a 4/6
Calicut ,,	Brownish	2/ a 3/
Mangalore ,,	Med Brown to good bold	3/ a 5/10
Ceylon, Mysore ,,	Small fair to fine plump	1/8 a 5/6
Malabar ,,	Fair to good	1/7 a 1/8
Seeds, E. I. & Ceylon ,,	Fair to good	1/7 a 1/8
Ceylon "Long Wild" ,,	Shelly to good	1/ a 1/6 nom.
CHILLIES, Zanzibar cwt.	Dull to fine bright	100/ a 110/
Japan ,,	Fair bright small	80/ a 89/
CINCHONA BARK.—lb. Ceylon	Crown, Renewed	3⅜d a 7d
	Red Org. Stem	2d a 6d
	Red Org. Stem	1⅜d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅞d a 4d
CINNAMON, Ceylon 1sts. per lb.	Fair to fine quill	11d a 1/6
2nds.	,, ,,	10d a 1/5
3rds.	,, ,,	9d a 1/3
4ths.	,, ,,	8d a 1/
Chips.	Fair to fine bold	3d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1/2
Amboyna ,,	Dull to fine	10½d a 11d
Zanzibar ,,	Fair and fine bright	7¼d a 7⅜d
Madagascar ,,	Fair	7⅛d
Stems ,,	Fair	1⅜d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	,,
COCOA, Ceylon Plant. ,,	Special Marks	85/ a 90.6
	Red to good	78/ a 84/
Native Estate ,,	Ordinary to red	57/ a 82/
Java and Celebes ,,	Small to good red	70/ a 98/
COLOMBO ROOT ,,	Middling to good	32/6 a 40/
CROTON SEEDS, sifted ,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	160/ a 180/
GINGER, Bengal, rough ,,	Fair	35/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	50/ a 70/
Cochin, Rough ,,	Common to fine bold	40/ a 47/6
	Small and D's	40/
Japan ,,	Unsplit	38/
GUM Ammoniacum ,,	Ord. blocky to fair clean	60/s a 85s
Animi, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,, ,, ,, little red		£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
,, ,, red		£4 a £7
Arabic, E. I. & Aden ,,	Ordinary to good pale	45/ a 55/ nom.
Turkey sorts ,,	... ...	62/6 a 65/
Ghatti ,,	Sorts to fine pale	20/ a 32/6
Kurrachee ,,	Reddish to good pale	25/ a 35/ nom.
Madras ,,	Dark to fine pale	20/ a 32/6 nom.
Assafœtida ,,	Clean fr. to gd. almonds	£15 a £20
	com. stony to good block	£4 a £10
INDIGO, E.I. Bengal lb.	Shipping mid to gd. violet	14/6 a 15/6
,,	Consuming mid. to gd.	13/9 a 14/6
	Ordinary to middling	12/6 a 13/6
,,	Mid. to good Kurpah	8/9 a 11/
,,	Low to ordinary	6.6 a 8.6
,,	Mid. to fine Madras	4/6 a 5/6
KAPOK-Ceylon lb.	Ordinary to good	5d 7d
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	60/ a 70/
Somali ,,	,, ,,	50s a 60s
MACE, Bombay & Penang per lb.	Pale reddish to fine	1/10 a 2/
	Ordinary to fair	1/8 a 1/10
Java	,, ,, good pale	1/10 a 2/
Bombay	Wild	5d

	QUALITY.	Quotations.
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	1/6 a 1.9
	80's	1/2
	110's	10d
NUX VOMICA, Cochin	Ordinary to good	20/ a 23/
per cwt. Bengal		18/ a 20/
Madras	,, ,,	18/ a 21/
OIL OF ANISEED lb.	Fair merchantable	3/5½
CASSIA ,,	According to analysis	3/10 a 4/1
LEMONGRASS oz.	Good flavour & colour	1¾d
NUTMEG ,,	Dingy to white	1½d a 1¾d
CINNAMON ,,	Ordinary to fair sweet	5d a 1s 6d
CITRONELLE lb.	Bright & good flavour	2/
OLIBANUM, drop ,,	Good to fine white	55s a 60s
,,	Middling to fair	45s a 50s
pickings ,,	Low to good pale	20/ a 35/
siftings ,,	Slightly foul to fine	25s a 35s
ORCHELLA WEED—cwt.		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	8¾d
Ceylon ,, ,,	Fair to fine bold heavy	8d a 8½d
Singapore ...	Fair	7⅞d
Acheen & W. C. Penang	Dull to fine	nom.
(White) Singapore ,,	Fair to fine	9½d a 10d
Siam ,,	Fair	9¾d
Penang ,,	Fair	9¼d
Muntok ,,	Fair	9⅛d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 3/
Canton ,,	Ordinary to good	1/6 a 2/3
High Dried ,,	Fair to fine flat	1/3 a 1/4
	Dark to fair round	7d a 8d
RUBBER, INDIA lb.	Fine Para smoked sheets	2/3
Ceylon, Straits, ,,	Crepe ordinary to fine	2/3½
Malay Straits, etc. ,,	Scrap fair to fine	1/9½
Assam ,,	Fair 11 to ord. red No. 1.	1/6½
Rangoon ,,	,, ,, ,,	1/7½
Borneo ,,	Common to good	1/7½
Java ,,	Good to fine red	1/10
Penang ,,	Low white to prime red	1/6 a 1/7
Mozambique ,,	Fair to fine red ball	2/1
,,	Sausage, fair to good	2/1
Nyassaland ,,	Fair to fine ball	1/11
Madagascar ,,	Fr. to fine pinky & white	1/6
,,	Majunga & blk coated	1/3
,,	Niggers, low to good	9d a 1/2
New Guinea ,,	Ordinary to fine ball	1/9 a 2/
SAGO, PEARL, large—cwt	Fair to fine	24/6 a 25/
medium ...	,, ,,	24/6 a 25/
small ...	,, ,,	21/ a 23/
Flour ...	Good pinky to white	18/ a 19/
SEEDLAC cwt.	Ordinary to gd. soluble	55/ a 90/
SENNA, Tinnevelly lb.	Good to fine bold green	1/ a 1/1½
	Fair greenish	10d a 11d
	Common specky & small	6½d a 8½d
SHELLS, Mo' PEARL—		
Egyptian cwt.	Small to bold	50/ a £5 10/
Bombay ,,	,, ,,	60/ a £5 10/
Mergui ,,	Chicken to bold	£6 10/ a £10 10
Manilla ,,	,, ,,	£6 10/ a £10
Banda ,,	Sorts	30/
Green Snail ,,	Small to large	55/ a 75/
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	25/ a 26
per cwt. Madras	Inferior to good	Nominal.
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	10/ a 25/
	Pickings	5/ a 15/
Ceylon	Small to bold	10/ a 20 nom.
TURMERIC, Bengal cwt.	Fair	35/
Madras ,,	Finger fair to fine bold	35/ a 37/6
Do. ,,	Bulbs ,, ,, [bright	23/
Cochin ,,	Finger fair	35/ nom.
	Bulbs ,,	25/
VANILLOES— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	7/ a 12/
Madagascar ... } 2nds.	Foxy & reddish 3½a ,,	5/6 a 7/6
Seychelles ... } 3rds.	Lean and inferior	5/6 a 6/
WAX, Japan, squares, cwt.	Good white hard	67/6

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